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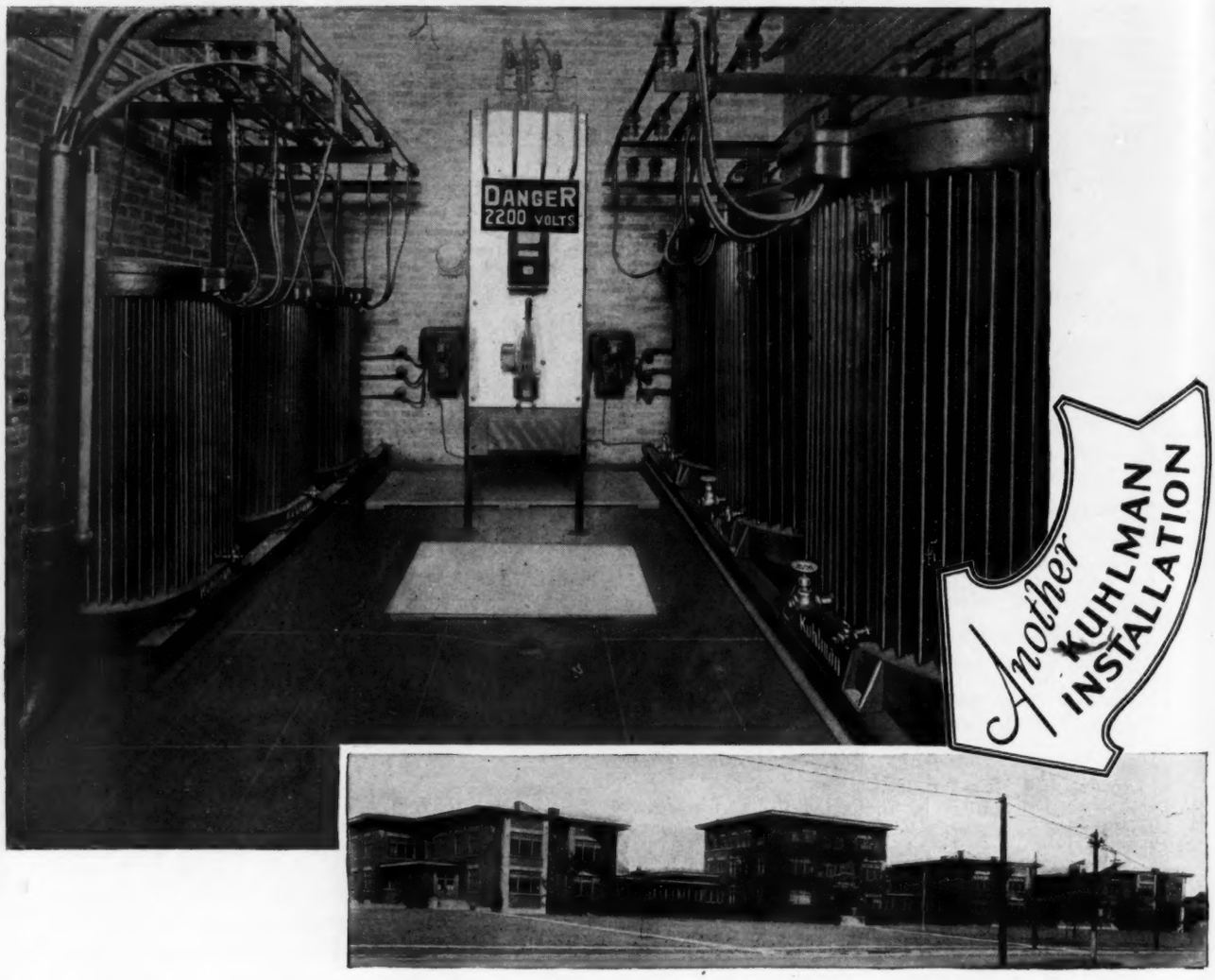

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W. H. ONKEN, JR.
Editor

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Investigation for Facts Welcomed

RUMBLINGS of investigations of the light and power industry by Congress persist. They should be met with confidence and courage. Any red-blooded man resents the idea that he should be investigated, for the proposal carries with it a suggestion of wrongdoing or evil intent. But the utility industry will welcome any comprehensive and thorough investigation if it be conducted by qualified investigators who are not ruled by prejudice or political bias. As the case is stated by P. H. Gadsden: "Such an investigation would be helpful to the whole industry, but especially to those well known and well established groups the soundness of whose financial methods is abundantly attested by the favored position their securities hold in the investment market and the wisdom of whose public policies is reflected in the cordial relations which they enjoy with the communities they serve." Mr. Gadsden again proves his wisdom when he says: "We are not going to organize lobbies in Washington. We shall take our message to the people of the United States. Our appeal will be made to the sound business common sense of the American people. Our security holders, more than five million of them, are scattered over every state in the Union; more than one million men and women are in our employ, and we owe it to them that the fine picture of our business be shown clearly to the people of this country."

Facts overcome propaganda and political efforts to exploit situations. The facts indicate that the industry is sound and well managed, and they arm its leaders to defeat the object of inquiry designed primarily to promote partisan ends. American business has attracted the best brains and character to be had. American politics has, on the whole, attracted inferior talent. Political management of business undertakings can present only a sorry spectacle in contrast with the amazing efficiency which has been exhibited by private enterprise as typified in the operations of the light and power industry. Industry leaders such as Mr. Gadsden have the courage to face any political situation with courage and with an intelligent program. The outcome need not be doubted.

* * * *

Working Through Customers' Organizations

WITHOUT detracting one iota from the value of man-to-man contacts in spreading the public utility gospel of service under economic conditions, the fact remains that through intercourse between customers' organizations and power companies much can be done that is very difficult to achieve when working along limited individual lines. Take the rural service problem. Slowly but surely the farmer is coming to understand its economic difficulties as faced by the electric companies. It would be a waste of time to try to prorate the credit for the growing comprehension of the situation in the more intelligent agricultural circles between the utilities and the farmers' organizations, but the confidence felt by the farmer in the grange or other group of tillers of the soil to which he belongs is a real asset in the frank discussion of rural-line extensions and rates by companies which have striven to make their problems clear to such bodies.

The industry does well to co-operate with such organizations even at the cost of considerable time and effort, in order that the farmer may understand all the better, through men of his own calling, the facts that control the cost of serving him electrically. As time goes on we expect to see still closer and more friendly contacts between utility companies and the many customers' organizations through which the individual may be reached, without in the least sacrificing the human relations so many companies are building on the man-to-man basis in their territories.

* * * *

The New and Greater South Asks Unhampered Power Supply

INDUSTRIALLY and electrically the South is experiencing a renaissance. The affluence that was hers before civil strife reduced her to penury is fast returning and on a greater and grander scale. It might have come sooner had there been a truer realization of the relation between industrial development and prosperity. However, corporation baiting is now a thing of the past and the importance of electricity to industry has also been recognized.

Of the various states, North Carolina was perhaps the first to see the light, and her industrial giants received great inspiration and aid from the late James B. Duke, than whom no greater pioneer in Southern hydro-electric development was to be found. Cotton, tobacco, woodworking and other industries dot the landscape on all sides; decentralization of industry is an accomplished fact, thanks to the network of electric power lines, and contentment and riches abound. The sister states of North Carolina were quick to sense the cause of her prosperity, Mississippi among the last, and now all are seeking industries and electric power and leaving nothing unturned to that end. It is a happy omen when the business men of eastern Tennessee insist on the development of the power sites on the Clinch and Upper Tennessee Rivers without further delay from Washington and when Mississippi clamors for power from Muscle Shoals.

It was in such an atmosphere that the Southern Appalachian Power Conference was held at Chattanooga last week, and, indeed, out of the conference came a clearer conception of the mutuality of industry and power

and a better understanding between the public and the manufacturers with reference to working with natural resources. Muscle Shoals naturally came up for discussion, and it is evident that the industrial leaders of the South do not see eye to eye with those of her political leaders who seek government operation of the plant. On the contrary, business is articulate in demanding that Muscle Shoals energy shall be distributed for the benefit of the entire South and that the government shall do nothing to block such a consummation. The South is awake to its opportunities and enthusiastic concerning the outcome. It is forging ahead faster than any other section of the country, and any agency or political group that attempts to stay the progress of that forward movement had best beware. The South has opened its doors to capital, and if it does not experience an era of still greater prosperity, it will not be because it has been backward in hydro-electric development or has withheld a welcoming hand to industry.

* * * *

Creating Public Interest in Utility Affairs

POPULAR interest in the activities of the utility industry is immensely worth obtaining and holding; in fact, without this the future development of the light and power business would be slow and uncertain. It is safe to say that the people are today better informed than ever before upon matters relating to public service companies, but it is a question whether their interest in the work of these organizations is still more than a small fraction of what it should be. In appraising the weight of public sentiment many executives are prone to exaggerate the diffusion of interest and to assume that the average citizen is far more concerned than is the case. These executives might ask themselves how much real personal interest they themselves have in the problems and technique of water supply, mail service, chain stores, motor-car distribution and many other activities which touch their daily lives, so long as they receive first-class service at fair rates.

Life is too full and too swift in these times to permit the ultimate consumer to devote his attention to the problems of every major service which he enjoys, but there is a latent capacity for interest and action in the average man and woman which cannot safely be overlooked and which wise executives are always seeking to capitalize into a friendly feeling for their organizations. Through security ownership, alert service, fair prices, intelligent publicity, attractive property, "human" employees and in many other ways electrical service men may hope to obtain and revivify popular interest in their industry. Their companies are always doing interesting things, but modern competition for attention is so great that unless some one makes a business of creating public interest in company affairs, many citizens will never feel more than a tepid concern and many more will pass their days in utter indifference, only to be shaken if cause for complaint arises or when some politician or newspaper launches an attack upon the power companies. The electrical industry need not assume that it has an inferiority complex because so much remains to be done before the general public acquires an active, continuing and pervasive interest in its daily affairs. Rather let it be thankful that momentum in arousing this interest has already been attained and seek to enhance it.

Experiences with Modern Stations

OPERATING data from many highly economical steam power stations are now available. They should be evaluated for the benefit of designers of stations now on the horizon. Many differences in design and installation are embodied in the stations recently placed in service, and the fire of actual operation should have tried out controversial factors to a degree where conclusions may be drawn.

The test of any station is measured in terms of the total cost of energy at the busbars based on an equality in service standards. An increase in fixed or labor charges may more than offset a decrease in fuel costs, and a station used for standby or low-load-factor operation should not be compared with a base-load or metropolitan station where reliability is paramount. But some technical and economic data can be had which measure progress. All-metal furnaces versus furnaces with thin refractories, two-, three- and four-point bleeding, the relative merits of electrical and mechanical ash precipitation systems with pulverized-fuel plants, the single-pass versus the multiple-pass condenser, equipments for combustion control and vacuum maintenance, auxiliary drives and control apparatus, and other technical elements illustrated by installations, are well worthy of study in order to fix a few facts and principles.

Another measure of value is in the determination of the capacity use of power-station apparatus. For example, what proportion of total generator capacity has been used while units were operated? What is the proportion of reserve system generating capacity required with and without interconnected lines? What is the economic effect of forcing boilers and stokers to high ratings? What is the total economic gain from the use of higher steam pressure? The "shake-down" period is passed for many of the new stations, and before another power-station building year arrives it would be well to consolidate information and facts from operating installations. The new stations have proved efficient as a whole, but certain details are well worthy of study.

* * * *

I. E. S. Convention Shows Demand for More Light

THE twenty-first annual convention of the Illuminating Engineering Society, held in Chicago last week, was more than a series of business sessions at which papers were presented and discussed. Rather it was a conference of the illumination engineer and his clientele where they took stock of and appraised the year's accomplishments, discussed ways and means of practical application and set about the solution of new problems. Attendance at the convention and membership in the society both set new high records this year, signifying broader interest in the work of the illuminating engineer. But even more significant of the growing importance of correct illumination to industry, business and human welfare are the closer relations that are being established between the society and other associations, government officials and the actual users of illumination, all of these being represented at the convention. These relations between the I. E. S. and other organizations will no doubt be fostered and encouraged to the fullest.

Another indication pointing to more complete application of illuminating engineering principles is the increas-

ing number of central-station companies and central-station men who are members of the society. It is through the lighting service departments of these companies that much of the scientific research of the illuminating engineer is finding practical application. The utility companies have always been keenly interested in lighting, and it is encouraging to see their sales activities along this line based on sound engineering ideas.

Essentially the I. E. S. is a technical organization whose work must first be done by exhaustive test and experimentation in the laboratory. But this is only preliminary to practical utilization. The public wants more and better light and is coming to the illuminating engineer for it. The convention this year showed that the society could not hide its light under a bushel even if it wanted to.

* * * *

Combining Industrial Substations

CONSERVATION of capital investment in supplying power to industries is desirable from every point of view. Such a course enables utility companies to compete more effectively with mill plants when the final economic balance sheet is totaled. Even where central-station energy wins "hands down," the avoidance of needless outlays profits both seller and buyer of service. It is the never-ending task of the engineer to force the invested dollar to top-rate performance, and for this reason multiplication of investment in transmission and distribution equipment beyond that required for first-class service should not be tolerated.

Recent observation of various mill-power applications in two Eastern manufacturing centers reveals a tendency toward the multiplication of substations that should be critically studied by utility and industrial engineers. This condition has grown out of the gradual development of mill business on the electric service systems as well as the slow piecemeal expansion of individual mill properties. One large mill group was found to have three substations at which purchased power was received, and no interconnections were provided between the buses except in a roundabout manner through the utility company's feeder system. In another case the power-company program for the acquisition of future mill loads embraces a comprehensive development of a feeder system embodying the construction of a new substation or at least the installation of appropriate transformer banks and switching equipment on the site of each added customer's establishment. Without a thorough investigation of each situation it would be premature to condemn either of these solutions of the problem of bulk supply to industry as mistaken, but it is clear from inspection that the possibilities of a more highly centralized substation layout should be weighed more carefully by engineering departments.

Piecemeal acquisition of mill-power contracts may be inevitable, but it is open to question whether in some cities the pendulum has not swung too far in the direction of relatively small industrial substation installations. The theoretical savings of combined transformer groups centrally located and feeding important industrial plants by independent lines present too attractive a picture to be overlooked. Progress in automatic-substation and remote-control practice has led many engineers to favor the decentralization of step-down transformer banks. There is no single solution to these problems, but it is open to doubt if utility men have taken full advantage of load diversity and centralization.

Where Utilities and Dealers Differ in Their Thinking

CENTRAL-STATION sales managers and the non-electrical merchants who sell electrical appliances don't talk the same language. This fact stood out clearly at the conference held last week at the call of C. E. Greenwood, chairman of the N.E.L.A. merchandising committee. There were present the officials of the national associations representing the department, hardware, furniture and house-furnishing stores and the electrical dealers. The national representatives of the drug stores were unable to be present. The meeting was called for the purpose of developing, if possible, a national standard of merchandising practice for the guidance of all classes of dealers who retail electrical equipment to the home, in the hope that misunderstandings between the power companies and the other dealers over selling practices might be avoided in the future. The dealers responded eagerly to the suggestion.

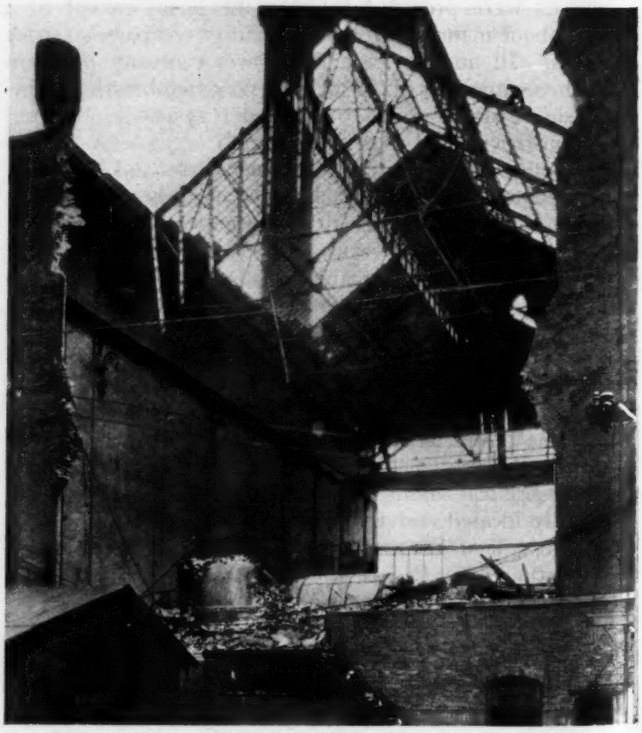
But there is a simple underlying difference between the thinking of the power-company sales manager and that of the department store or hardware man, and this probably provides the basis of most of the bad feeling that has existed in so many cities. The power-company man is ever conscious of the load-building objective. The other dealer is not. The central-station man recognizes a period of pioneering in the early life of each important appliance in which money and effort must be invested by some one in educational promotion that it may be popularized more quickly and load the lines. But the regular merchant looks upon this as the period of experimental development when the manufacturer should bear the burden. To him it has not yet become merchandise, for he is not interested in any device until it has won enough public acceptance to make it sell. In other words, the electrical man thinks of merchandising primarily as the introduction of appliances into use in the home. The department-store man thinks of merchandising in terms of so displaying and advertising goods that people will come and buy them. It is just a technicality, perhaps, but it holds these men far apart in their approach to this common problem.

And so the non-electrical merchant feels aggrieved that the central-station company, which enjoys an earning on the sale of energy also, should compete with stores that are dependent for their prosperity on merchandising profits alone. They are suspicious of public utility accounting in which losses on appliance selling can so easily be buried in operating expense, by absorbing costs of delivery, collection, service and the like. They wonder, anyway, why the utility should not be satisfied with selling the energy and leave the storekeeping to established stores. They fail to recognize the extent to which the power company's promotional activities accelerate the development of the market and directly increase sales for every local retailer. And it is natural enough that they should feel this way, for their minds are in the market place, their interests lie in trade. They have never been concerned with load building.

But this conference has achieved a fine step toward understanding on both sides. For these views were discussed fully, and a committee embracing representatives of each dealer group will now take up the problem, resolve it into its principles and if possible agree upon standards of practice acceptable to all. This contact will broaden both points of view.

Utilities Demonstrate Capacity for Public Service After Tornado

THE St. Louis tornado of Sept. 29 surpassed in actual loss the storm of 1896 and caused a loss to power companies of about $1,000,000, but the facilities afforded by interconnected plants and the unceasing labor of all available repairmen and engineers from power plants and general offices enabled the utility companies, after the storm cleared, to restore service rapidly wherever it could be used. The extent of the damage was reported in the Oct. 8 issue of the ELECTRICAL WORLD. By 3 a.m. on the day following the tornado the Union Electric Light & Power Company had restored service to 80,000 of the 120,000 patrons who had suffered interruption. The Laclede Power & Light Company also made good time in restoring service to the majority of the 14,000 customers affected. By midnight of Friday the Illinois Power & Light Company had power available in all towns served, despite the loss of the Cahokia high-tension line service and damage to the Venice generating station and substation.



Ratio-Differential Relay Protection

By using relays that automatically exert reverse torque and raise pick-up on through faults, drawbacks of ordinary differential protection are avoided—Characteristics and performance

By H. P. SLEEPER

Protection Engineer Public Service Electric & Gas Company, Newark, N. J.

FIG. 1 — TYPICAL INSTALLATION OF RATIO-DIFFERENTIAL RELAYS

THE efficacy of differential relays for the protection of electrical apparatus has long been recognized because of their speed of operation and immunity to through faults. Ordinarily overload relays are used, connected differentially between the two sets of current transformers, one on either side of the apparatus to be protected. The ratios are chosen so that on through-power flow the secondary currents of the current transformers are equal and circulate by virtue of the series connection. No current enters the relay circuit, because of its relatively high impedance. Hence, under load or through short-circuit conditions, the relays are unaffected. An internal fault, however, causes an unbalance in the currents of the differentially connected current transformers and may even cause reversal of the current in one. This causes the overload relays to operate.

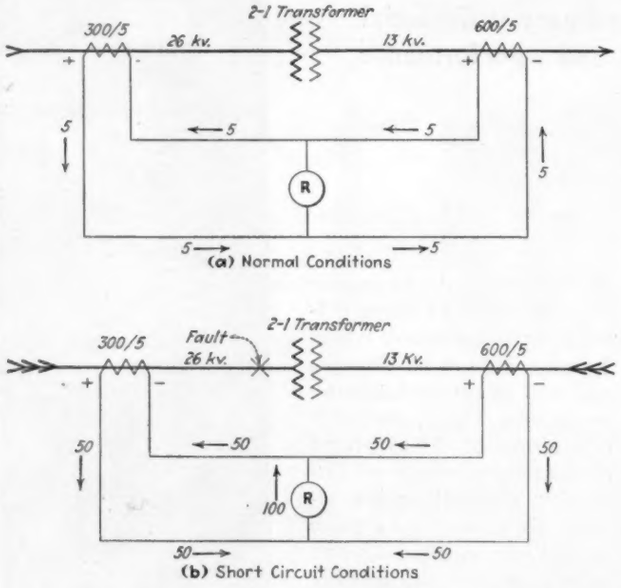
The foregoing results are obtained under ideal conditions: (1) Equal lengths of leads from each set of current transformers to the relays; (2) two sets of current transformers of the same type; (3) identical ratio characteristic curves up to short-circuit current values of possibly twenty times normal; (4) exact and fixed power transformer ratios; (5) accurate selection of the proper auto balancing current transformer taps, and (6) zero current in the relay under all normal conditions. Such ideal conditions ordinarily exist in differential protection of generators. But they are usually absent on one or all counts in differential protection of transformers. The reasons are obvious.

Consider a simple case of a modern power station. The generating and switching equipments are indoors. The high-voltage transformers are in the outdoor substation. This inherently eliminates three of the ideal conditions. First, since the low-voltage switches and the switchboard are located indoors and the high-voltage breakers outdoors, the lengths of secondary leads to the relays are not equal. They may become radically different if the outdoor structure is considerably removed from the power house. Lead ratios up to 10 to 1 or even greater are met in practice. Second, the indoor current transformers will usually be of a different type from the outdoor. The indoor current transformers may be either the wound or small-core bushing type. The outdoor current transformers will almost invariably be of the large-core bushing type. Of necessity the leakage reactances and excitation characteristics of these differently constructed transformers will not be the same and will cause performance variations. Third, the modern economic design of current transformers of dissimilar nominal ratios almost invariably gives a radical variation of their ratio characteristics at high current values. Variations of 10 to 50 per cent are found in practice between commercial transformers of standard ratio ranges.

What is the effect of the preceding not uncommon conditions on the efficiency of such protection? Just this: A normal unbalance in electromotive forces results at the terminals of the current transformers. It obviously requires more voltage to push 5 amp. through 2,000 ft. of control cable than to push it through 200 ft. Hence the volt-ampere burden on the two sets of current transformers is not the same. This difference in burden alone displaces the two respective characteristic curves, even if they were otherwise coincidental. The practical effect is the same as an inherent ratio error. In addition there is another effect which usually overwhelms the first and is unfortunately accumulative with it. This is the ratio-characteristic error due to dissimilar nominal ratios and to dissimilar design characteristics of the different types of current transformers.

To illustrate, consider a very ordinary case. A bank of 45,000-kva. delta-delta transformers is differentially protected by overcurrent relays. The voltage ratio is 13.2 kv. to 132 kv. The low-tension current transformer ratio is 500 to 1. The high-tension ratio is 50 to 1. The bank has an impedance of 7.88 per cent. A short-circuit

occurs on a high-tension feeder close to the high-tension bus. The bank will pass 12.7 times 1,970 amp., or 25,000 amp at 13.2 kv. The low-tension current transformers should deliver 50 amp. to the relay. The high-tension current transformers should also deliver 50 amp. to the relay to balance the low-tension current. But the ratio of the large bushing-type current transformer falls off 20 per cent at 1,000 per cent normal full-load current and only 40 amp. is delivered to the relay. The difference (10 amp.) passes through the relay. If the relay is to remain inoperative, it must be set for a pick-up current



FIGS. 2*a* AND 2*b*—DIFFERENTIALLY CONNECTED OVERLOAD RELAYS OPERATING UNDER NORMAL AND ABNORMAL CONDITIONS

value in excess of 10 amp., or else for a delayed operating time. Such an absurdly high setting, representing a pick-up value greater than 66,000 kva., is a very distinct hazard to proper protection for faults in the transformer.

The time element is equally objectionable. No account has been taken of the unbalanced lead lengths which would further aggravate the situation and should be considered in practice. Likewise, it is frequently impossible in practice to choose current transformer auto taps to balance out entirely all differential current from the relay, even at full load. This, of course, becomes magnified under short-circuit conditions and requires a still higher current setting on the differential relay in order to prevent improper operation.

The sad part of the situation assumed is its economic inevitability. The variation in lengths of leads is easily compensated, either by using different sizes of control cable or more practically by using auxiliary resistors to balance the two legs of the relay circuit. But the error from all previously discussed causes, due to variations in characteristics, cannot be compensated at more than one point between the curves of any two transformers and hence is valueless. The obvious remedy is to move the mountain to Mahomet and make the curves identical. This is theoretically possible but economically impractical at this time, requiring, as it would, radical design changes in bushing-type transformers.

What is the answer? Happily, it is an economical one and simple as well. In effect the relay can be made to recognize the situation and automatically raise its pick-up when a through-fault occurs. It is even better than that. A reverse torque can be exerted under these conditions to hold the relay open. What more could be desired?

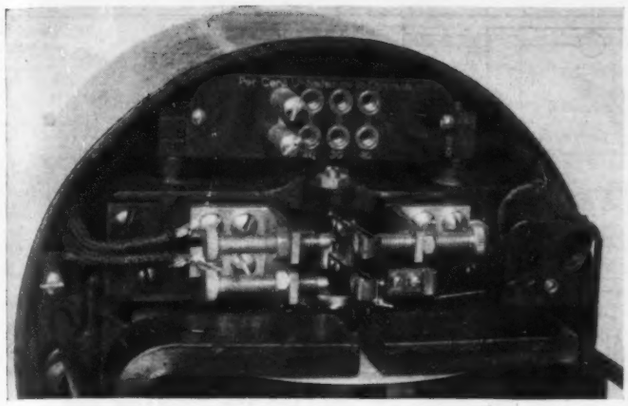
A Relay with Intelligence

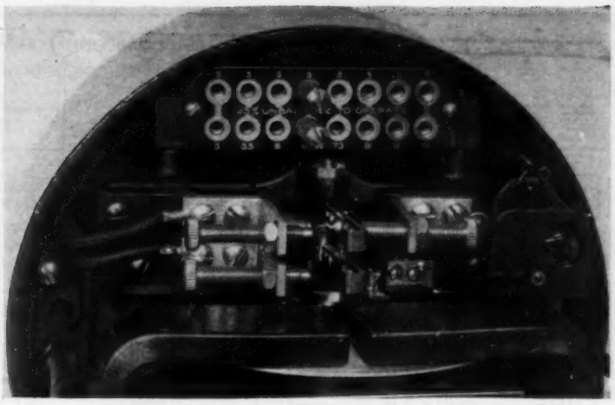
A device having these features of intelligence has been invented and patented by a prominent operating engineer in one of the large public utilities of this country and is being manufactured by the Westinghouse Electric & Manufacturing Company. It is called the type "CA" ratio differential relay. It is made for both generator and transformer protection. It operates on the differential principle, but not at a fixed current value. The relay has two restraining coils, wound accumulatively, which normally circulate load current and hold the relay open. A third, or operating, coil is connected differentially between the two current-transformer circuits. The cooperation of all three coils is required to operate the relay and a ratio effect is thereby secured. A certain ratio of unbalance between the two incoming currents is required to unbalance the relay sufficiently to cause it to close contacts. This ratio is fixed.

This ratio operating characteristic is the feature of the design. It serves a double purpose, for on a carefully balanced differential circuit which will hold its balance under all conditions, such as on generator protection where identical current transformers are used on both sides of the winding, it enables an extremely sensitive setting to be used. It is obviously very desirable to do this so as to detect low current faults, such as those near end turns. It is perfectly safe to use this low setting

TABLE I—PERFORMANCE RECORD OF RATIO-DIFFERENTIAL RELAYS ON TRANSFORMER INSTALLATIONS

Case No.	Rating (Kva.)	Voltage (Kv.)	Transformer Connections	Period in Service to 10-1-27 (Mo.)	Relays Operated Correct	Relays Operated Incorrect	Remarks
1	45,000	132-13.2	Y-delta	18	1	..	Workman caught on 13.2-kv. bus.
2	45,000	132-13.2	Y-delta	18	..	1	Incorrect operations on through short on 13.2-kv. bus. Found current transformers incorrectly connected on 132-kv. side of transformer bank.
3	45,000	132-13.2	Y-delta	18	..	1	Same as above.
4	45,000	132-13.2	Y-delta	18	..	1	Same as above.
5	45,000	132-13.2	Y-delta	18	1	..	Steam pipe leaked onto potential transformer 13.2-kv. leads and insulator flashed over to ground.
6	45,000	132-13.2	Y-delta	19	1	..	13-2-kv. lead failed to ground in section of underground cable.
7	30,000	132-26.4	Y-delta (delta tertiary)	10	..	1	Operated incorrectly on through ground on 132-kv. line during relay tests. Found tertiary current transformers connected incorrectly.
8	45,000	132-13.2	Y-delta	19	1	..	13-kv. terminal board flashover.
9	30,000	132-26.4	Y-delta (delta tertiary)	10	1	..	Lightning flashed over 26-kv. transformer bus.
10	45,000	132-13.2	Y-delta	19	1	..	13.2-kv. lead failed to ground in section of underground cable.
11	45,000	132-13.2	Y-delta	18	1	..	Lightning broke down windings.
12	45,000	132-13.2	Y-delta	18	1	..	Lightning broke down windings.
13	45,000	132-13.2	Y-delta	18	1	..	Lightning broke down windings.
14	45,000	132-13.2	Y-delta	18	1	..	Lightning broke down windings.
15	45,000	132-13.2	Y-delta	19	1	..	132-kv. winding burned out.
16	45,000	132-13.2	Y-delta	19	1	..	132-kv. winding burned out.
17	45,000	132-13.2	Y-delta	19	1	..	13.2-kv. lead failed in section of underground cable.





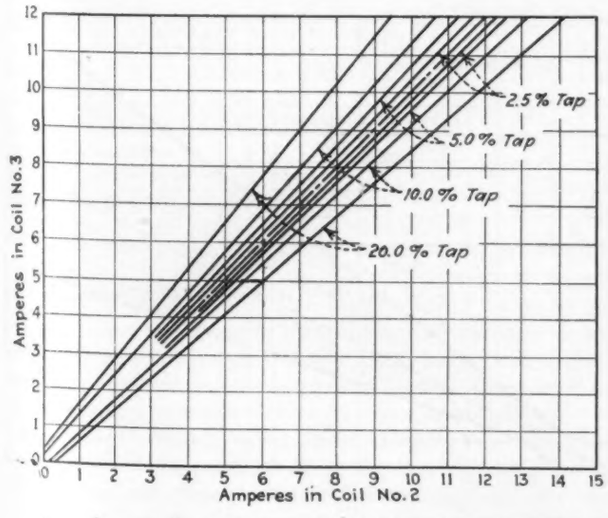
FIGS. 3*a* AND 3*b*—UPPER HALVES OF RATIO-DIFFERENTIAL RELAYS FOR GENERATOR AND TRANSFORMER PROTECTION RESPECTIVELY

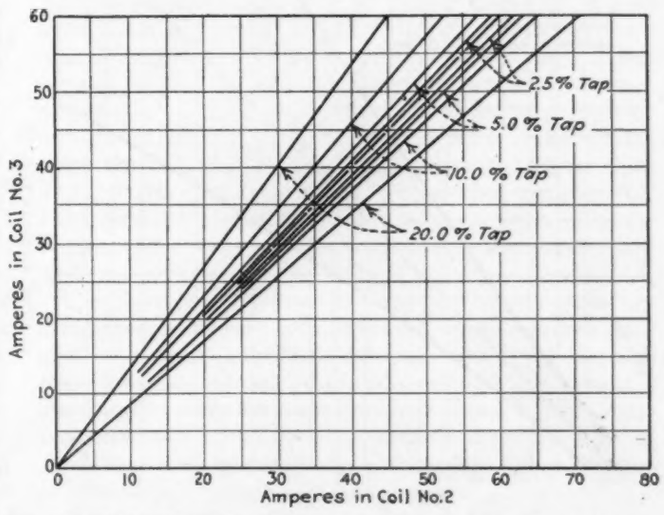
because of the presence of the normal restraining torque in this relay. This is accomplished by virtue of the three windings on the relay, which allow an actual opening torque to be exerted on the induction disk of the relay when the two currents in the relay are in the same direction. This opening torque is proportional to the sum of the two currents entering the relay. It is important to note that this opening torque also has a ratio characteristic. The higher the load on the generator the greater will be the restraining torque which holds the contacts open. Hence, on through short circuit, the relay is actually prevented from operating incorrectly. This "safety factor" is a feature of this instrument.

The generator relay, in common with the transformer relay, is of the induction type. It has the following taps, which are calibrated in per cent differential current to operate the relay: 2.5, 5, 10 and 20. The time of operation is practically instantaneous above 200 per cent of pick-up value. It may be observed that the characteristic curves of the relay are symmetrically displaced on both sides of the zero line, which means that the relay acts the same regardless of the direction of the unbalance. The disk is practically unrestrained, so that the curves reach almost to the zero point. Even at short-circuit current values the curves are symmetrical. It is assumed that the current transformers used with this relay will be identical in every way and that the lead lengths will be the same or properly compensated for variations in resistance.

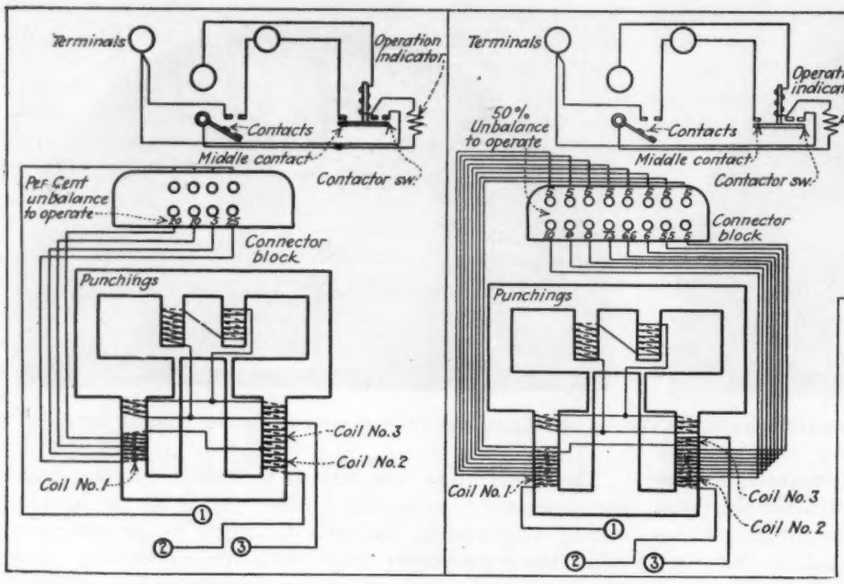
The transformer type relay is somewhat different from the generator type, as may be observed from the internal wiring diagrams of the two. Contrary to the generator relay, the transformer relay has a fixed operating value of 50 per cent unbalance. Also, the spring has an initial tension so that with zero current on either side, a current of approximately 2 amp. is required in the other side to close contacts. This is done to prevent improper operation during the charging period when the bank is energized from either side without load. This is a very brief period, only a few cycles at most, but may be sufficient to cause the relay to operate incorrectly because of its sensitivity and instantaneous operating time.

A further innovation, which is very desirable, has been incorporated in this relay. The necessity for using auxiliary current balancing auto current transformers has been eliminated by providing taps in the relay to take care of a 2 to 1 current difference in the two sides. Thus a normal current of 5 amp. from one set of current transformers can be balanced against a normal current of 2.5 amp. from the other set of current transformers without the use of external devices. The operating characteristics of the relay are in nowise changed by the incorporation or use of these balancing taps. This feature will be much appreciated by both construction and operating men, as they both deplore the necessity of the autotransformers heretofore existing. The old complications of mounting space for the autos, complicated connections and a multiplicity of tap lead connections are entirely





FIGS. 4*a* AND 4*b*—CHARACTERISTICS OF RATIO-DIFFERENTIAL RELAY FOR GENERATOR PROTECTION AT LOW AND HIGH CURRENT VALUES
Currents in the two restraining coils (Nos. 2 and 3) in same direction



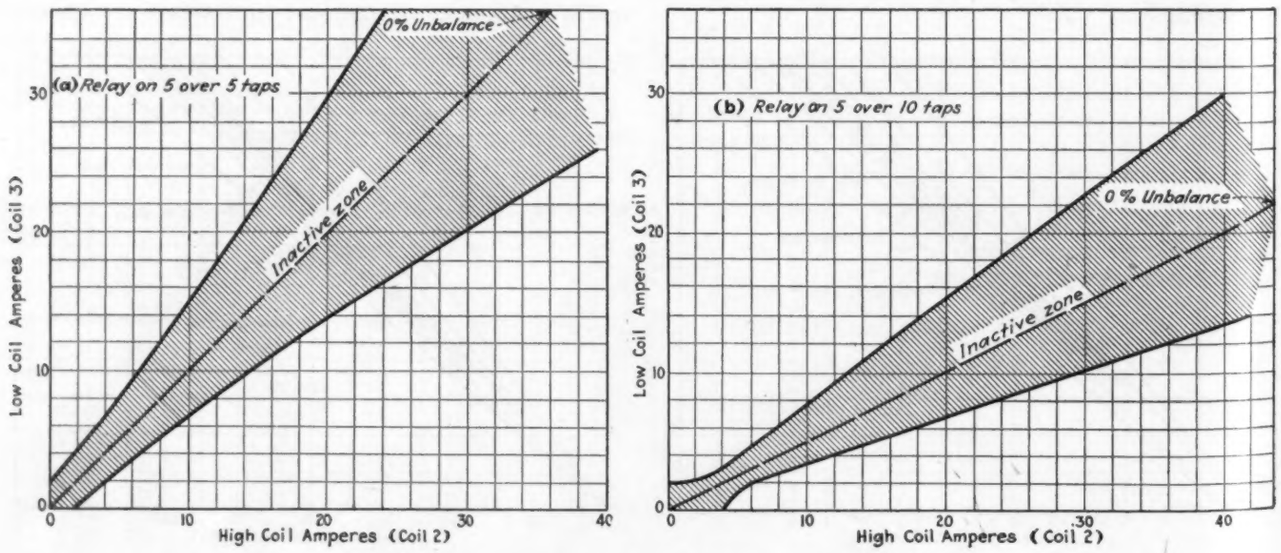
FIGS. 5 (LEFT) AND 6 (CENTER) — INTERNAL WIRING OF RATIO-DIFFERENTIAL RELAYS FOR GENERATOR AND TRANSFORMER PROTECTION RESPECTIVELY

FIG. 7 (RIGHT)—APPLICATION OF RATIO-DIFFERENTIAL RELAY TO STAR-DELTA TRANSFORMER BANK

eliminated. Moreover, it is no longer necessary to choose current transformers so exactly, as the 2 to 1 range of the balancing taps allows ample margin for the use of standard ratios. The following balancing taps are provided in this relay: 5 to 5 (to be used when the ratios are equal), 5 to 5.5, 5 to 6, 5 to 6.6, 5 to 7.3, 5 to 8, 5 to 9 and 5 to 10.

In the previously calculated case there resulted an unbalanced current of 10 amp. in the relay on through short circuit by reason of the poor ratio characteristic of the high-voltage bushing-type current transformer. This same current will be present, of course, in the "CA" relay under the same conditions, but with what effect? This undesirable unbalanced current is the difference between the currents delivered by the low-tension and high-tension current transformers, or equals 50 minus 40, or 10 amp. But the ratio of this unbalanced current is only 10 to 40, or 25 per cent. Since the relay requires 50 per cent unbalance to operate, it is evident that no incorrect operation can occur under these conditions. Moreover, the currents could have been further unbalanced to the extent of 50 amp. low tension and only 33.3 amp. high tension, which is 50 per cent ratio referred to the low-current value, before incorrect operation could have occurred. This is an inconceivable condition, but yet the relay would take care of it. The operation on short circuit is assured, since all the short-circuit current from at least the source side will flow through the relay to cause unbalance. If back feed is possible from the other side, it will reverse in the relay and the sum of the two currents will act co-operatively in the relay to cause it to operate. The relay becomes much more sensitive with the currents reversed in one side.

From the preceding discussion it is evident that the ratio characteristic of this relay takes care of all causes of improper unbalanced currents in the relay, with a large margin of safety. Hence it is no longer necessary to compensate for lead resistance unbalance; current transformers need not be of the same type in the case of transformer protection and no particular attention need be paid to their ratio characteristics. The relay will do the almost unbelievable and take care, automatically, of ratio changes on the transformer bank itself. With the old type of overload differential protection it was



FIGS. 8*a* AND 8*b*—CHARACTERISTICS OF TRANSFORMER TYPE RELAY
Currents in the two restraining coils (Nos. 2 and 3) in same direction

TABLE II—PHASING RESULTS ON RATIO-DIFFERENTIAL RELAYS FOR TRANSFORMERS

Apparatus	Rating (Kva.)	Transformer Voltage (Kv.) Prim.	Transformer Voltage (Kv.) Sec.	Current Transformer Ratio Prim.	Current Transformer Ratio Sec.	Phase	Relay Terminal — Left — Amp.	Left — Deg.	Right — Amp.	Right — Deg.	Neutral — Amp.	Neutral — Deg.	Relay Tap	Calculated Tap
No. 3 transformer	45,000	132 (Star conn.)	13.2 (Delta conn.)	200/1	500/1	1	5.5	32	3.8	214	1.68	31	5/6.6	7.2
						2	5.5	272	3.8	94	1.7	269	5/6.6	7.2
						3	5.5	153	3.8	333	1.7	150	5/6.6	7.2

necessary to rebalance the differential each time a ratio change was made on the bank. The 50 per cent ratio differential characteristic of the "CA" relay allows it to handle a transformer ratio variation of plus or minus 25 per cent without changing the relay taps. Any expected variations of current transformer ratios must of course be discounted from the above-mentioned ratio changes so that the total unbalance on the relay on through short circuit will not exceed 50 per cent. This facilitates tap changing under load, as no special precautions are necessary in connection with the differential protection of the bank.

Several installations of these relays have been operating on the system of the Public Service Electric & Gas Company of New Jersey for more than a year. One typical installation is shown. Five installations of type "CA" ratio-differential relays for generator protection have been in operation for that time, but have had no occasion to function. Conversely, they have not operated incorrectly, but have stood several through short circuits successfully. The size of two of the units so protected is 52,500 kva., and that of the three others is 45,000 kva. There are eleven installations of the type "CA" ratio-differential relays for transformer protection now in service on this system. The banks protected vary in size from 30,000 kva. to 45,000 kva. On these installations there have been 13 correct and four incorrect operations. All other installations have had no occasion to operate; all have withstood many through short circuits successfully, and there have been no failures.

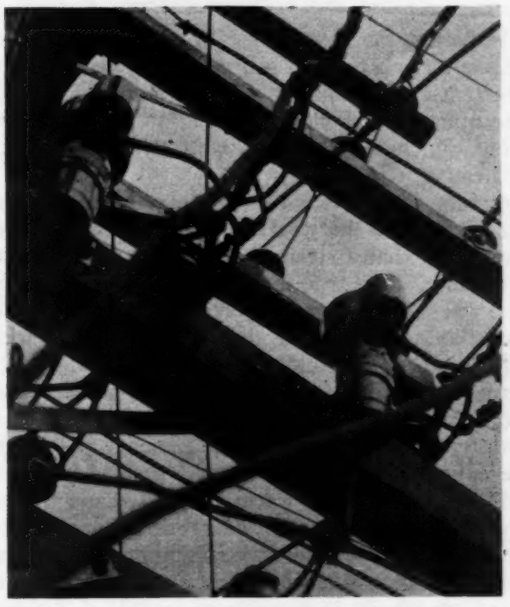
All of the incorrect operations mentioned were due to wrong current transformer connections and should have been detected when tested. However, as these were the first installations made, the proper methods of test were not fully understood. As a matter of fact, this type of relay is far simpler to test than any other type of differential protection in use today. It is really one of the outstanding characteristics of the relay and a distinct argument for its use. A set of correct phasing results on a transformer type relay is shown.

Arrester Protection for Watt-Hour Meters

By Carl J. Fuhrmann
District Superintendent of Electric Meters Consumers Power Company, Jackson, Mich.

WATT-HOUR meter failures caused by electrical storms are a source of considerable expense in territories where overhead three-phase, three-wire power distribution is in use. At times the damage done by storms taxes the electric meter department to the full extent of its capacity in replacing meters that have been damaged or destroyed. This condition is aggravated by the now common practice of grounding the meter base by means of a steel back-plate and trim. In addition to the expense of replacing and reconditioning damaged meters, there is also the loss in registration of energy. After careful consideration it will be discovered that these costs amount to a considerable figure in the course of one storm season. They can be materially decreased by the installation of secondary lightning arresters of the proper voltage rating at properly chosen locations on the three-phase power secondary circuits.

In order to determine the proper location for the installation of these arresters, it is necessary that a record be



TYPICAL SECONDARY LIGHTNING ARRESTER PROTECTION

kept of the location of all meters damaged or destroyed by lightning. It will be discovered that lightning is a fairly consistent performer and will strike in the same locality several times over a period covering several storms. Long secondaries are of course the greatest cause of trouble, but this is not always the rule. Short secondaries can be and are sometimes a source of considerable trouble in meter failures. After a reasonable number of checks, arresters should be installed at the point where meter failures have occurred two or more times. The arresters should be installed on the pole from which the customer's service connection is made. It does not always prove effective, as meter protection, to install arresters at the ends of long secondaries.

We have found since the installation of secondary arresters, judiciously located, that polyphase meter failures have been reduced to almost nothing. It has also been found that trouble calls originating from lightning disturbances have been materially reduced. The investment cost and cost of installation of these arresters are so small that their use is easily warranted. The protection is invaluable.

Previous to the summer of 1926, when the arresters were installed, meter failures varied between 10 and 15

per cent of the total in service. In 1926 the failures dropped to 4.6 per cent of the total in service. The arresters were installed during the latter part of the summer of 1926, but it so happened that the most severe storm occurred after that time. So far in 1927 only 1 per cent of the total meters in service have been lost on account of lightning, and most of these losses were on secondaries not protected by arresters. Definite figures as to the reduction in the number of trouble calls due to lightning disturbance are not available, but there is a general feeling that the number of these calls has been materially reduced.

Parallel Operation with Industrial Plants*

By E. A. Gruppe
Utica Gas & Electric Company

IN POWER sales work one of the difficult jobs that frequently occurs is to sell purchased power to plants in which use for exhaust steam is found. The latter may be utilized for building heating or for process work, which may include drying, washing, dyeing or other hot-water heating.

Contracts for service to such plants are difficult to obtain because of the widespread belief that where use is found for exhaust steam the power is a byproduct and costs nothing. It is true that a non-condensing engine or turbine uses only a small percentage of the available heat of the steam, but the determination as to whether or not the power is actually a byproduct should be based on actual test and survey of the entire plant operation.

There are cases where the exhaust steam requirements constantly exceed the power requirements and where all of the exhaust steam is used. The turbine in a case of this kind acts merely as a reducing valve and the power generated is a byproduct. The use of central-station service would under normal conditions be limited to either night operation, when few motors and few lights are used, or wholly to emergency service if the turbine is run 24 hours.

There are other cases where only a small percentage of the exhaust steam available is used, the remainder being wasted to the air or to a condenser. In cases of this kind investigation may show that the value of the steam is greatly outweighed by the cost of operating the turbine, including cost of steam lost to condenser or atmosphere, repairs, supplies, value of energy used by auxiliary pumps as well as pro-rata cost of boiler and grate repairs, supplies, etc. In cases of this kind it works out generally that with a normal power rate it would pay to shut down the turbine completely and purchase the entire power and light requirements.

Between these two extremes there is a large percentage of industrial plants that have use for exhaust steam varying not only from season to season according to the heating requirements but also from day to day according to the process requirements. It is to serve these plants that parallel operation is proposed.

Assume a 1,000-kw. bleeder-type turbine running with a 700-kw. load ten hours per day for 5.5 days per week of 4.3 weeks per month. The turbine is shut down nights and a small amount of power is purchased during this time and Sundays to the amount of 35,000 kw.-hr. per month. The steam input into the turbine is at the rate of 31.4 lb. per kilowatt-hour, or 22,000 lb. per hour. Of this, 20,000 lb. is bled for process work, the remainder being wasted into a condenser.

The condenser pump requires 40 kw. and consumes 9,460 kw.-hr. per month. The economics of the proposition are shown in the accompanying table. In setting up these figures no interest or depreciation is shown nor is any labor included.

Subject discussed at the annual meeting of the commercial section of the Empire State Gas and Electric Association.

Operating Own Turbine and Purchasing Service at Night

Cost of coal equivalent of turbine input = (22,000 × 236.5 × 6) ÷ (7 × 2,000)	$2,225.00
Purchased 35,000 kw-hr.	904.05
Turbine oil and repairs	50.00
Cost	$3,179.05

Shutting Down Turbine and Purchasing Entire Requirements

	Kw.-Hr.
Generated 700 kw. × 236.5 hr.	165,550
Purchased	35,000
Generated and purchased	200,550
Credit for condenser motor	9,460
Total kw.-hrs. used	191,090

Net kw. demand = 700 — 40 = 660 kw.

191,090 kw.-hr. on basis of 660 kw.	$3,243.14
Cost of coal to produce 20,000 lb. steam per hour (20,000 × 236.5 × 6) ÷ (7 × 2,000)	2,025.00
Cost	$5,268.14

Loss to customer = $5,268.14 — $3,179.05 = $2,089.09 per month.
Gain to utility, $3,243.14 — $904.05 = $2,339.09 per month.

Operating the Turbine Non-Condensing in Parallel with Purchased Service

The water rate on the turbine will then be 20,000 lb. per hour, which is equivalent to an electrical load 570 kw. The load on the central station will be 700 — 570 = 130 kw.

	Kw.-Hr.
Utility service 130 kw. × 236.5	30,800
Purchased for night operation	35,000
Total purchased	65,800

65,800 kw.-hr. on a basis of 130 kw. demand	$1,072.96
Coal required for turbine	2,025.00
Turbine repairs and supplies	50.00
Cost	$3,147.96

Saving to customer, $3,179.05 — $3,147.96 = $31.09 per month.
Increased revenue to utility, $1,072.96 — $904.05 = $168.91 per month.

This is only an example and there are many factors that enter into these calculations. The larger the turbine involved and the greater the load purchased from the central station the greater will be the saving effected, because the cost of purchased power decreases with an increase in quantity, whereas the cost of generating power is more nearly a straight-line relation.

These calculations do not take into consideration fixed charges of any kind, hence the savings by elimination of condenser, pumps, cooling water pumps, apparatus, etc., on first cost will be increased.

Methods of Parallel Operation

To secure parallel operation many different systems are in use:

1. The control may be made entirely automatic. In this case the back pressure in the bleeder line or the exhaust line, or both, may govern the amount of energy supplied by the turbine.

2. The division of load may be manually controlled.

Lever Brothers, Cambridge, Mass., have a turbine that supplies bleeder steam at 65 lb. pressure and exhaust at 15 lb. The control is automatic-mechanical and is actuated through pressure in the respective mains. The Goodall Worsted Company, in Sanford, Me., has a 1,000-kw. turbine which is automatically controlled by back pressure in the exhaust main. In case of an interruption of the purchased supply, a selective time-delay relay cuts out previously determined sections of the load on the company's own generator until the turbine has a safe load. The Chase Company of Waterbury, Conn., manufacturer of brass tubing, generates 10,000 kw. and purchases 7,500 kw. The Scovill Manufacturing Company, also of Waterbury, manufacturer of brass tubing, generates 10,500 kw. and purchases 5,000 kw. The Stanley Works of New Britain, Conn., manufacturer of tools, generates 1,500 kw. and purchases 5,000 kw.

Parallel operation is a new tool for solving the problem of selling purchased service to the consumer who has use for exhaust steam. Its advantages may be summed up as follows:

1. Reduces cost of power to consumer by eliminating losses to a condenser.
2. Insures continuous service to industries such as paper manufacturing, where a continuous supply is essential.
3. Permits plant expansion at minimum cost.
4. Increases sales of purchased service.

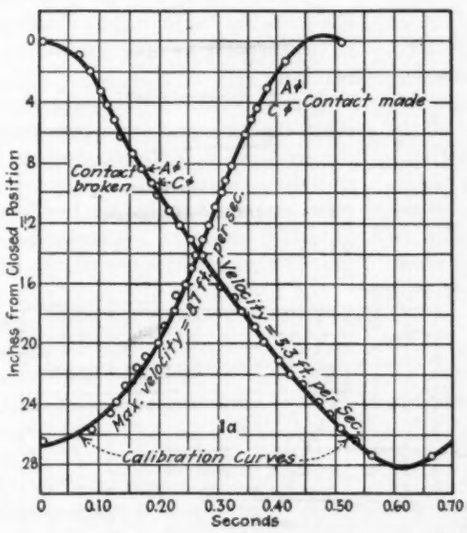
High-Voltage Oil-Circuit Breakers*

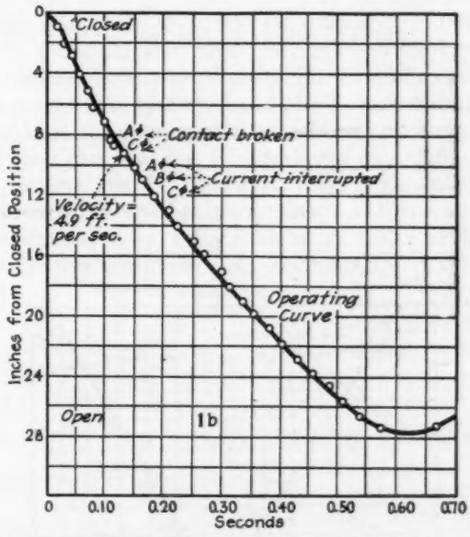
Functional requisites of equipment for high-tension transmission networks. Contact designs and operating speeds bear close relation to improved performance

By Roy Wilkins and E. A. Crellin

Assistant Engineers Division of Hydro-Electric and Transmission Engineering
Pacific Gas & Electric Company, San Francisco, Cal.

THE growing knowledge of the important part played by the oil-circuit breakers in a transmission network is stimulating investigations on the part of the operating companies to satisfy themselves as to the best circuit breaker for use on a given system. It is economically unfeasible for a manufacturer to maintain equipment for the testing of oil-circuit breakers with a rating of 2,000,000 kva. or more at 220 kv. Tests conducted at manufacturers' plants are not conclusive, as it is impossible to duplicate conditions on an extensive interconnected transmission network where recovery voltage, resonant surges, etc., are variable and indeterminate. The only way by which it is now possible for an operating company to satisfy itself of the suitability of any series of circuit breaker design is by carefully supervised tests on its own system. Present knowledge must be amplified by more test data.





FIGS. 1A AND B—CHARACTERISTICS OF A 110-KV., 400-AMP. MULTIPLE-BREAK OIL-CIRCUIT BREAKER

The calibration curve indicates the time necessary to accomplish the opening or closing of this breaker when no circuit is interrupted and the operating curve indicates the points at which each phase, contact and current interruption point occurs. In this case the main contacts part after 3 or 4 in. of travel from the closed position, whereas the arcing contacts do not part until 8 or 10 in. of travel has been obtained. This requires 0.075 second, about four cycles on a 60-cycle system.

The immediate problem is to combine in one oil-circuit breaker all the good features now available in the designs of the several manufacturers. If it were possible to construct such a breaker, it would be better to separate the contacts the required distance and then introduce the oil at the zero point on the voltage wave. This is not a practical possibility and it is therefore necessary to have the contacts immersed in oil at all times. Many substitutes for oil have been proposed and tried with varying degrees of success, and of these a high vacuum

**Excerpts from a paper presented at the Pacific Coast convention of the American Institute of Electrical Engineers, Sept. 13 to 16, 1927.*

seems to offer the greatest possibility of an ultimate solution to the problem. A ½-in. travel of contacts in a high vacuum is equivalent to a great many inches of travel under oil, and many possibilities present themselves. The practical application of the knowledge is a real problem. An exceptionally high vacuum must be continually maintained under service conditions and means must be developed for moving the breaker contact the necessary inch or so within this vacuum before the switch can be made ready for general application.

Present knowledge of oil-circuit breaker design indicates the desirability of a composite breaker embodying the advantages of the design of several manufacturers. These are:

1. The total operating time for a complete open-close-open cycle of operation at rated current and voltage shall not be more than 0.2 second.
2. The arcing time shall approach as close as possible to the ideal of one-half cycle.
3. The energy for the switch operation shall be stored and available for instantaneous release. The mechanism should not have a power demand in excess of 1 kw.
4. The breaker shall be capable of completing 100 normal operating cycles before any inspections or adjustments are necessary. (If requirements 1 and 2 are met successfully, there should be no trouble in reaching 1,000.)
5. The breaker shall be so designed that it can be installed, adjusted and maintained by average mechanics without special training in oil-circuit breaker technique.

Accelerating springs are used at present on most of the high-voltage oil-circuit breakers. They may be compression or tension springs or both and in some cases both types may be found in the same breaker. Such springs are for the most part extended or compressed, depending on the type, by the final action of the closing mechanism of the breakers and serve both as a damping agent on the closing stroke and for acceleration of the contacts on opening. In certain cases the contacts themselves serve such a purpose. There are two major objections to the accelerating springs in general use: First, their effect is minor as far as a reasonable amount of speed is concerned, the maximum recorded being about ½ ft. per second, and second, they absorb energy at a time on the closing stroke when it cannot well be spared from most types of closing mechanisms. If greatly strengthened, they could rise to uncertain closing and hair trigger adjustments, already too much condemned by operating engineers to require further discussion. Suffice it to say that present-day breakers require too many critical adjustments and development must be toward a reduction in their number rather than any tendency to make them more critical.

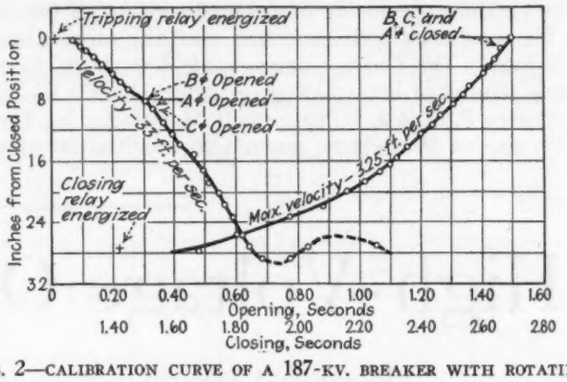
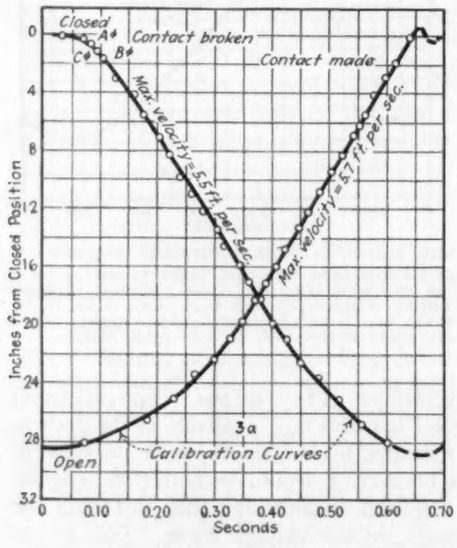


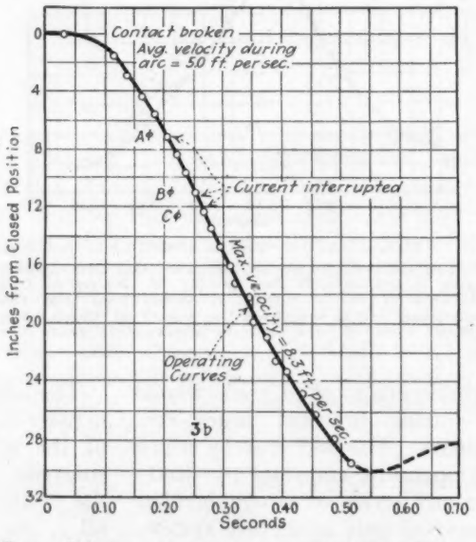
FIG. 2—CALIBRATION CURVE OF A 187-KV. BREAKER WITH ROTATING RELEASE ARCING TIPS

In this breaker the main contacts part about 1¼ in. from the closed position and the quick break auxiliary contacts about 10 in. for the closed position. This requires about 0.25 second, or fifteen cycles, on a 60-cycle system. The speed obtained on a quick-break contact control is about twice that of the main contact, so that the arc when started is extended at about three times the main contact speed.

Contact speeds in present-day breakers range from 3.5 ft. per second to somewhat less than 7 ft. per second, corresponding to 2.4 and approximately 5 miles per hour. Present-day high-speed direct-current circuit breakers have a speed of approximately 200 ft., or 55.6 miles, per hour.

Quick break contacts usually take the form of auxiliary contacts and serve two purposes: First, to increase the separation between contacts in a given time—that is, to reduce the time of arcing—and second, to preserve the main contact surface by breaking the arc on replaceable auxiliary contacts. Increased contact speed may also be gained through the use of the explosion chamber type of contacts. In this type the speed break is obtained by virtue of the gas pressure in the contact chamber acting on the rod as a piston. The gas pressure is generated by the arc acting on the oil within the explosion chamber and depends upon the clearance between the contact rod and the explosion pot entrance bushing and amount of oil volatilized. The amount of oil volatilized depends upon the current in the arc and time of arcing. This means that high currents will cause increased contact speed over lower current.





FIGS. 3A AND B—CHARACTERISTIC CURVES FOR A 115-KV., 400-AMP. EXPLOSION CHAMBER BREAKER

The calibration curve and the curve for operation when the breaker is interrupting 300 amp. of line-charging current have been superimposed for comparison. In this type of contact clearances are determined by the maximum amount of current being interrupted and the maximum speed in contact members. The maximum speed was 5.5 ft. per second. In this type of breaker increased contact speed is obtained to the detriment of the insulating oil used in the breaker.

Low-tension circuits for heavy duty are, however, customarily equipped with external reactors to reduce the duty on the oil-circuit breakers and are considered sound practice, even though they entail a continuous loss often for the sole purpose of protecting the oil-circuit breaker momentarily during trouble. The mechanical design of high-tension oil-circuit breakers is not yet advanced to a point where the resistance feature can be added without reducing the mechanical reliability of the breaker below a safe minimum in many cases.

Maintenance and Inspection in Copper Mines

RIGID maintenance and inspection at frequent intervals have been found necessary on all underground circuits and electrical equipment of the Anaconda Copper Mining Company's mines to keep them in safe and reliable operating condition. In fact, it is only by the most careful inspection and maintenance that the equipment can be kept in operating condition at all. Maintenance in the 28 mines is divided among three general electrical foremen, who report directly to the electrical superintendent. Organization of the electrical department of the mining company showing how it functions was indicated in the Oct. 1, 1927, issue, page 674. This carries the organization down to one mine only for sake of simplicity.

Under the general electrical foreman in charge of a group of mines there is a boss electrician, as he is called, who is directly in charge of all electrical equipment in the mine. Under the boss electrician in the Leonard mine there are eight men. Two are shop men who handle practically everything of a maintenance character on equipment that is brought to the surface, except the rewinding of motors, which is done in a general shop for all mines. Five men devote their time exclusively to inspection and maintenance in the mine. These men can be located at any time in case of trouble during the day shift, but for emergency calls at any time during the 24 hours a special trouble man is on duty at the surface at all times. One of the five maintenance men spends his time exclusively on haulage locomotives. In this particular mine there are fifteen trolley locomotives and six storage battery locomotives.

Trolley locomotives are inspected once every two weeks and storage battery locomotives twice a week, at which time the batteries are inspected and watered. Each Sunday one of the storage battery locomotives is given a thorough inspection and any necessary repairs are made. Under this schedule each locomotive is gone over once every six weeks.

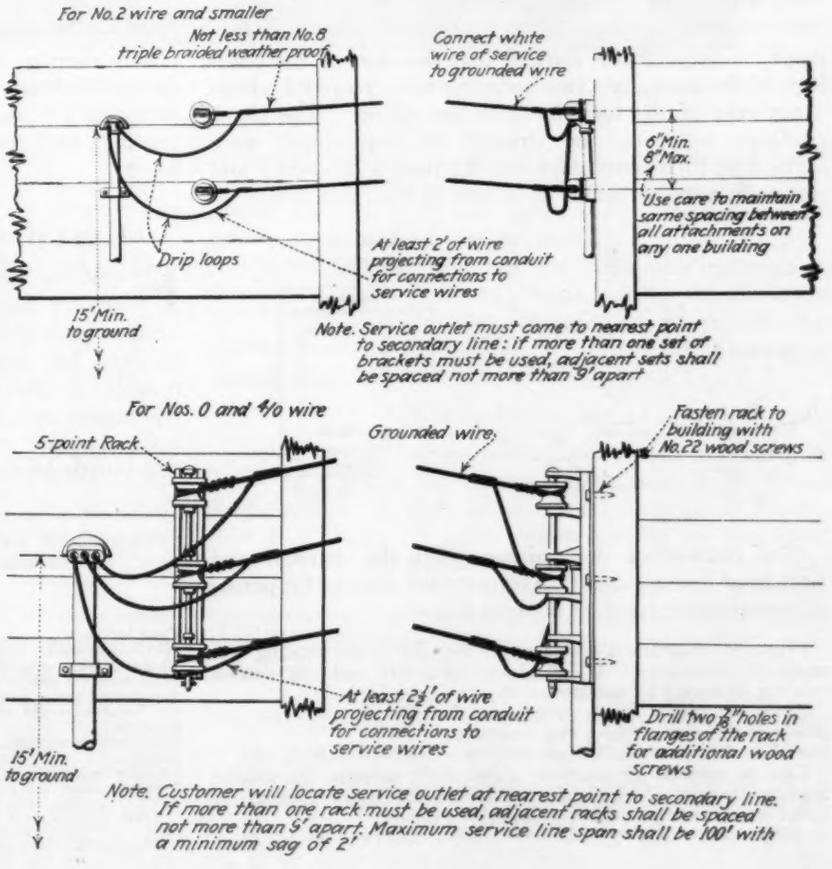
The four other men on day shift devote their time to general inspection and repair throughout the mine. Pump motors and compensators are inspected twice a week, but less important equipment goes longer without inspection. A log is kept in the mine electrical shop of all work performed and a record in triplicate is made on a form provided for the purpose. The original of this record goes to the mechanical department for attention in case mechanical equipment is involved; the duplicate goes to the electrical superintendent, and the triplicate is returned in the book for the records of the particular mine. A card record is kept of all electrical equipment in the mine and notations are made on the back of these history cards of any major repairs or changes in location of equipment. In case a piece of apparatus is transferred to another mine, a transfer slip is made out and the history card is sent to the electrical superintendent's office.

Multiple Supervision Records

As a check against the system of inspection outlined there is a general electrical inspector for all mines, who works directly under the electrical superintendent. This man makes periodic inspections of all mines and turns in his report to the electrical superintendent. A copy of this report goes to the mine superintendent of the particular mine concerned; another copy goes to the general electrical foreman over the mine, and a third copy goes to the master mechanic over all mines. This gives the electrical superintendent a check against the maintenance men in the individual mine, the boss electrician over the mine and the general electrical foreman over a group of mines. By means of this system and the design and layout of equipment described in the Oct. 1 number high continuity of service is maintained.

Attachment of Services at Buildings

Standards of the West Penn System


For No. 2 wire and smaller
Not less than No. 8 triple braided weather proof
Connect white wire of service to grounded wire
6" Min. 8" Max.
Use care to maintain same spacing between all attachments on any one building
Drip loops
At least 2' of wire projecting from conduit for connections to service wires
15' Min. to ground
Note. Service outlet must come to nearest point to secondary line: if more than one set of brackets must be used, adjacent sets shall be spaced not more than 9' apart
For Nos. 0 and 4/0 wire
5-point Rack
Grounded wire
Fasten rack to building with No. 22 wood screws
At least 2½' of wire projecting from conduit for connections to service wires
Drill two ⅞" holes in flanges of the rack for additional wood screws
15' Min. to ground
Note. Customer will locate service outlet at nearest point to secondary line. If more than one rack must be used, adjacent racks shall be spaced not more than 5' apart. Maximum service line span shall be 100' with a minimum sag of 2'

Correcting an Industrial Metering Installation

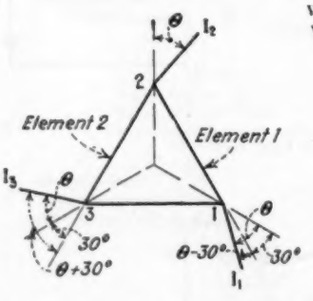
AN EASTERN power company supplying an industrial plant with energy during a period of business expansion noticed from time to time, as load was added, that the combined graphic demand and watt-hour meter indicated considerably less than that originally estimated and planned for the connected load, whereas the power factor meter showed such a low operating power factor that it was apparently off scale (60 per cent). Tests on the meter installation disclosed that the polarity of a potential transformer was reversed from that indicated by the polarity markings. This caused the torque of the reversed meter element to subtract from instead of add to the other element, producing low meter indications, and only about 55 per cent of the true energy consumption was recorded. The situation was remedied by the simple expedient of reversing the secondary leads inside the potential transformer tank, connections also being changed to the power factor meter as indicated in the accompanying diagrams.

Following the changes in connections, check readings were made by the central-station company at its generating plant, at the substation nearest the mill and at the mill itself. Computations showed that the sum of the readings of the company's two outgoing meters agreed within 1 per cent of the total input to the circuit. The check readings following the changes in connections were carried on for twenty days and the usages of energy and demands were corrected as shown in the table above.

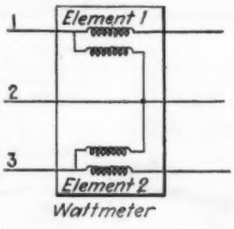
	15-Min. Demand Max. Kilowatts		Kw.-Hr. Usage	
	Indicated	Corrected	Indicated	Corrected
January	412	741	169,360	304,800
February	460.8	829	180,480	324,900
March	460.8	829	245,760	442,400
April*	950	950	420,480	440,020

*Metering corrected April 4. Correction in kilowatt-hours covers period from April 1 to 4.

Registration after April 4 was correct. Correction factor based upon 72.2 per cent power factor.



VECTOR DIAGRAM OF WATTMETER CIRCUIT



The method of determining what the demand and watt-hour meters should have recorded during the period of transformer reversal is given below:

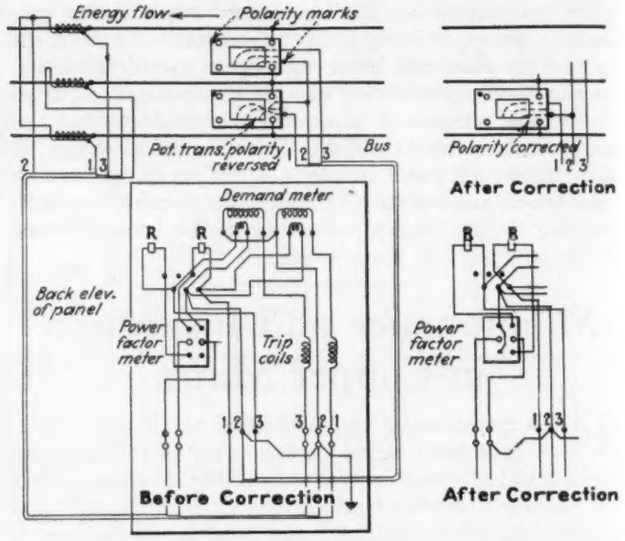
From the diagram it will be seen that the larger reading element (1) indicates: $W_1 = EI \cos (\theta - 30)$ and the smaller reading element (2) indicates: $W_2 = EI \cos (\theta + 30)$.

Since the power factor is greater than 50 per cent, the true power is the sum of these two readings:

$$W_o = W_1 + W_2 = EI [\cos (\theta - 30) + \cos (\theta + 30)] \quad (1)$$

Due to reversal of potential transformer polarity the smaller reading element (2) was subtracted from the larger, causing the meter to indicate an incorrect amount of power.

$$W_x = W_1 - W_2 = EI [\cos (\theta - 30) - \cos (\theta + 30)] \quad (2)$$



LEFT—WIRING OF 13-KV. METER CONNECTIONS AS FOUND. RIGHT—WIRING OF 13-KV. METER CONNECTIONS AS CORRECTED

The ratio of correct to the incorrect reading is:

$$R = \frac{W_o}{W_x} = \frac{\cos (\theta - 30) + \cos (\theta + 30)}{\cos (\theta - 30) - \cos (\theta + 30)} \quad (3)$$

From equation 3 it will be seen that the correction factor R depends only on the true power factor angle (θ) of the circuit in question. Also that the lower the power factor the smaller the value of R.

Computation of Correction Factor.—To obtain the proper value of power factor, readings were taken from the graphic power factor meter chart. This meter was checked and found to be correct.

The average power factor for a 48-hour period (April 10 to 12) was found to be 72.2 per cent and the corresponding power factor angle is 43 deg. 47 min.

Substituting this in equation 3 gives:

$$R = \frac{\cos (43° 47' - 30°) + \cos (43° 47' + 30°)}{\cos (43° 47' - 30°) - \cos (43° 47' + 30°)} = 1.806$$

Or, for the purpose of the inquiry say 1.8.

The average fifteen-minute load as determined by test for a 103-hour period was 237.5 kw. The correction factor of 1.8 was applied to both demand and watt-hour readings and settlement made by the customer on this basis.

Cost of Installing Fault Locaters

FROM the data sheets of a Massachusetts power company are taken the following itemized costs in connection with the purchase and installation of two fault locaters for detecting the position of line and cable troubles in the field by the use of portable telephone equipment and apparatus for impressing a signal wave upon the line under test from the substation. About one-fourth of the total was labor cost.

TWO FAULT LOCATERS INSTALLED IN TWO SUBSTATIONS
(Including Coils, Exploring Rods and Telephones)

Items	No. of Units	Price per Unit	Sub-Totals
Fault finders	2 sets	$477.00	$954.00
36x12x1¼-in. slats	2 boxes	6.63	13.26
10-amp., 10-kv., open-air plug switches	4	6.05	24.20
Plugs complete with handle	4	3.40	13.60
1-in. Sheraduct	60 feet	0.069	4.18
No. 8 double-braided, rubber-covered wire	150 feet	0.034	5.08
Sundries			0.79
Miscellaneous material			16.47
Labor			348.79
Liability insurance			21.98
Transportation			17.16
Total			$1,419.51

Electrolytic Zinc Production

Anaconda Copper Mining Company uses 50,000 kw. at the Great Falls zinc plant. Heavy currents constitute chief problems at present

GENERAL VIEW OF ELECTROLYTIC ZINC CELLS IN GREAT FALLS PLANT OF ANACONDA COPPER MINING COMPANY

HYDRO-ELECTRIC energy available in large blocks at low cost from the Missouri River plants of the Montana Power Company at Great Falls, Mont., has made possible the commercial production of electrolytic zinc by the Anaconda Copper Mining Company at this point in the largest electrolytic zinc plant in the world. The plant has a rated capacity of 335 tons of pure zinc each 24 hours or 20,000,000 lb. per month.

Power is fed by the Montana Power Company at 110,000 volts, 60 cycles to the zinc plant substation, where it is stepped down to 406 volts, six-phase for supplying eight 5,800-kw. rotary converters, each delivering 10,000 amp. at 580 volts direct current. The plant has a maximum demand varying between 45,000 and 50,000 kw. and an annual load factor of 95 per cent at unity power factor. Power is purchased on a kilowatt-hour basis.

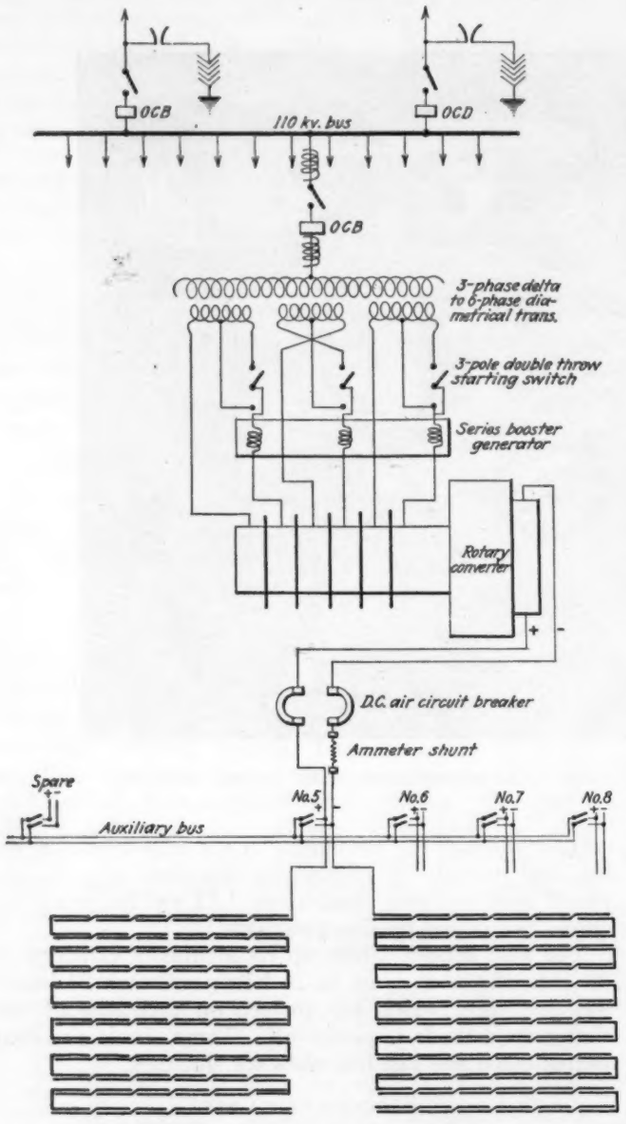
Before taking up the electrical features of the plant it may be well to review briefly the metallurgy and chemical reactions of the process. Zinc concentrates coming from the concentrator at Anaconda, Mont., are first roasted and the zinc is then leached out. In the leaching process all zinc oxide and zinc sulphate are dissolved in dilute sulphuric acid according to the reaction of zinc oxide plus sulphuric acid equals zinc sulphate plus water. The zinc sulphate is then purified and conveyed to the electrolytic cells through lead pipes. Passage of a direct current through the electrolyte in the cells breaks down the zinc sulphate by electrolysis into free oxygen, sulphuric acid and pure zinc, about 1.73 kw.-hr. being required per pound of zinc produced.

The zinc deposit builds up on aluminum cathodes at the rate of about $\frac{3}{16}$ in. in 24 hours and each 24 hours the zinc sheet which has formed on each side of the aluminum cathode is peeled off. These sheets are then melted down and cast into slabs for shipment.

Electrolytic Cells

An electrolytic cell consists of a pure lead anode about $\frac{3}{8}$ in. thick and a pure aluminum cathode about $\frac{3}{16}$ in. thick, both in the form of sheets or plates about 2x3 ft. in size. These electrodes are suspended in lead-lined wooden tanks by copper bars riveted across the top, one end of the bars resting on the tank and the other on copper contact bars. Each tank contains 27 sets of plates in multiple, constituting a cell, and a group of 144 such cells connected in series comprises a unit, which is supplied by a rotary converter delivering 10,000 amp. A constant current of 10,000 amp. is maintained in this series multiple circuit, which means that each cell containing 27 sets of plates in multiple carries 10,000 amp., or 360 amp. per set of plates. The voltage impressed on a unit of 144 cells is approximately 548 volts, making the drop across each cell 3.8 volts.

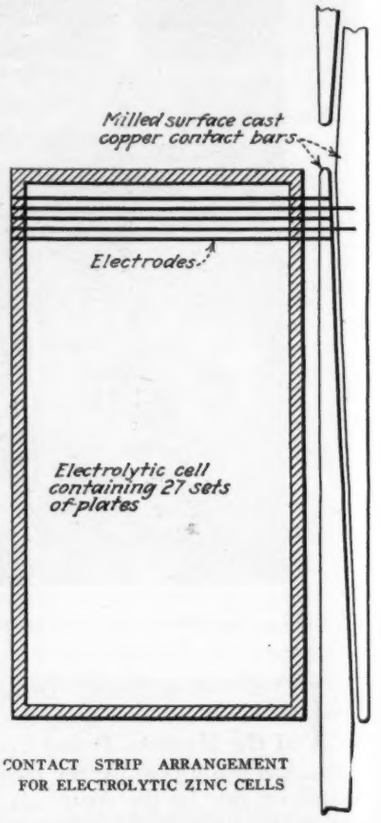
In order to economize on copper bus and to save space the electrode strips on the cells are made "V" or wedge shaped, as indicated in the accompanying sketch, diminishing in cross-sectional area as the current density decreases. The contact bars have a milled surface to insure good contact with the electrode-supporting bars. Connection between the electrode bars and the contact strips is made simply by the weight of the electrode plates on the electrode bars. The area of this contact is about 1 sq.in., and although there is a current density of approximately 360 amp. per square inch through the contacts, no trouble has been experienced due to heating. Each time the cathodes are raised for stripping the milled surface of the contact strip is polished to insure good contact. Moreover, the tendency to heat is very much reduced by the cooling effect on the electrode contact bars by the electrolyte which is kept flowing constantly from one cell to another by cascading the cells.



SCHEMATIC DIAGRAM OF CONNECTIONS FOR ONE TRANSFORMER, ROTARY CONVERTER AND ELECTROLYTIC CELL UNIT IN GREAT FALLS ZINC PLANT

The direct-current ends of the rotary converters are operated as ungrounded circuits, care being exercised to keep each electrolytic cell and the cell contact strips well insulated from ground at all points. The wooden tanks of the cells are set on blocks of glass 6 in. square and 2 in. thick; the contact strips are insulated from their cell supports by rubber strips. All steel columns are incased in wood, and to prevent grounding the circuit when the cathodes are raised for stripping, the chain blocks have an insulator between the hook at the top of the block and the monorail carriage. Voltage to ground from either side of the circuit is limited to 275 volts by grounding the bus connecting two groups of cells through a circuit breaker and a resisting grid of 1-ohm resistance. All the workmen in the cell room, on account of the acid, wear rubber shoes, which effectively insulates them from ground and no trouble has been experienced with shocks.

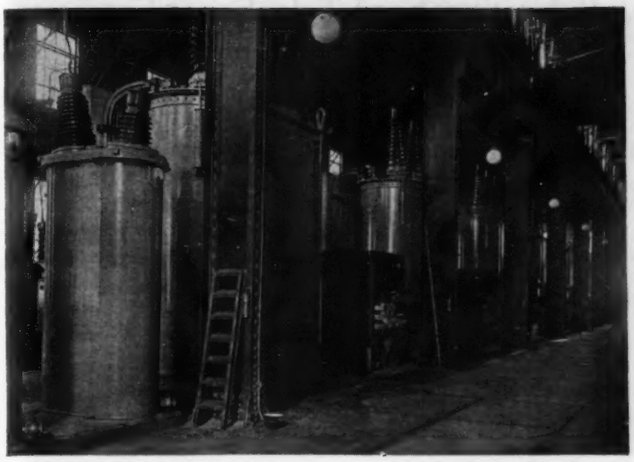
A unit scheme of current supply to the electrolytic cells is followed throughout, each group of 144 cells being supplied by a rotary converter having its own 110,000-volt, three-phase, to 406-volt, six-phase transformer. Eight such units, common only on the 110,000-volt side of the transformers, supply the 1,152 cells in the zinc plant. A ninth, or spare, unit has been provided for emergencies or for substituting for any machine that it may be desired to shut down for inspection or maintenance.



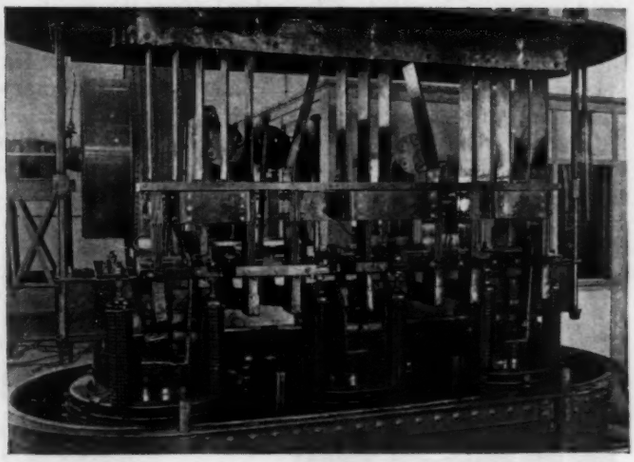
CONTACT STRIP ARRANGEMENT FOR ELECTROLYTIC ZINC CELLS

The scheme of switching and protection on each transformer, rotary converter and bus unit is shown in the accompanying schematic diagram. The oil circuit breakers on the incoming 110,000-volt lines and on the high side of the transformers are provided with overload and reverse power relays. Only two provisions are made for opening the circuit of a transformer and rotary unit under load. One is the oil circuit breaker on the transformer and the other is by heavy duty air breakers in the direct-current bus leading to the cell room. The direct-current breakers will operate on overload, reverse current or alternating current power failure, whereas overspeed of the rotary will open both the alternating-current and the direct-current breakers.

The rotary converters are started as induction motors by the operation of a heavy three-pole, double-throw knife switch, which cuts the machine in on half-taps on the low-voltage, six-phase transformer windings. The direct-current voltage of the rotary is controlled by varying its own field and by the 406-volt alternating-current input with field regulation on a 30-volt booster motor-generator set, the generator of which is in series with three legs of the six-phase supply. The generators of



CONVERTER TRANSFORMERS RATED AT 6,100 KVA., 110,000 VOLTS, THREE-PHASE, TO 406 VOLTS, SIX-PHASE DIAMETRICAL



TRANSFORMER CONSTRUCTION, SHOWING HEAVY BUSBARS FOR SIX-PHASE LEADS

the booster sets are rated at 420 kw. and are driven by 600-hp. synchronous motors. The rotary converters are operated at unity power factor, since maximum conversion efficiency is obtained under these conditions.

Large Currents Used

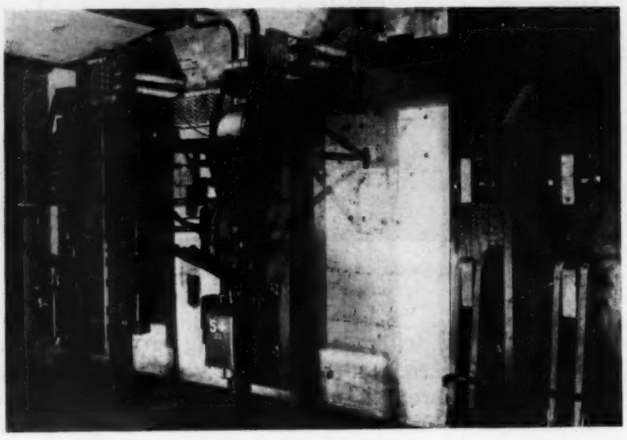
Handling of very large alternating-current and direct-current low-voltage currents is one of the chief problems in a plant of this kind. Each of the six-phase, 406-volt leads from the secondary windings of the 6,100-kva. transformers to the rotary converters consists of five 2,000,000-circ.mil flexible insulated cables grouped into phases. The direct-current leads from the machines to the bus carry 10,000 amp. and consist of eight similar conductors. For the direct-current bus cast-copper bars 2x7½ in., having a cross-sectional area of 19,000,000 circ.mil, are used, there being one such busbar for each leg of the circuit. From the converter station to the cell room the buses are carried through concrete compartments with busbars of like polarity grouped and separated from the buses of opposite polarity by approximately 3 ft. with a heavy concrete barrier between.

Each direct-current circuit from a rotary converter, after passing through the circuit breakers heretofore mentioned, runs directly to its unit of 144 cells. If it is desired to substitute the spare rotary for any other machine in operation, the double-pole disconnecting switches indicated in the diagram and shown in one of the accompanying illustrations are closed in on the dead auxiliary bus, which energizes the bus back to the two-pole direct-current breaker for the spare machine. The spare machine is then brought up to speed, the voltage properly adjusted and paralleled with the other machine through the direct-current breaker. After the load has been transferred from one machine to the other the sequence is reversed. This procedure is necessary due to the fact that it is highly important to maintain a continuous and constant current of 10,000 amp. on the electrolytic cells at all times, as they lose their efficiency for a time if shut down. As a precaution against a prolonged shutdown of a machine due to armature failure a spare rotary converter armature is kept on hand

NINE 5,800-KW., 580-VOLT ROTARY CONVERTERS DELIVERING 10,000 AMP. EACH FOR ELECTROLYTIC ZINC CELLS

and in case of burnout or for other reason the auxiliary rotary is operated while the armatures are changed.

The double-pole disconnecting switches used for placing the spare machine on any one of the eight rotary buses are of interest because of their size and the amount of current they must carry. As may be seen from the accompanying illustration they consist of what virtually



DIRECT-CURRENT 10,000-AMP. CIRCUIT BREAKERS (LEFT) AND HEAVY DISCONNECTING SWITCHES (RIGHT) GREAT FALLS ZINC PLANT

amounts to sections of bus hinged at one end and provided with bolted connection at the other. After a switch has been closed the hinge bolts and the bolts at the contact end are securely tightened to insure good contact.

Careful maintenance of the rotary converters, particularly of the brushes, is important, but ordinarily it is not necessary to shut down a machine oftener than once every two weeks for cleaning and brush inspection and replacement. Although both alternating-current and direct-current brushes are operated under the most severe conditions, little brush trouble has been experienced.

The question of rotary converters versus motor-generators for electrolytic plants always gives rise to considerable discussion. Both have certain advantages and are adapted to certain conditions. Under conditions at the Great Falls zinc plant, where voltage and current variation is required over a limited range only, the higher efficiency of the rotary converter makes its use desirable. At the Anaconda electrolytic zinc plant of the Anaconda Copper Mining Company, now being installed, the 1 to 2 per cent difference in efficiency between the two types of conversion equipment is being sacrificed in favor of greater latitude in current and voltage range, which may be desirable in this plant at times, and for sake of the power factor correction capability of synchronous motor-generator sets.

High-Pressure Steam in Sweden

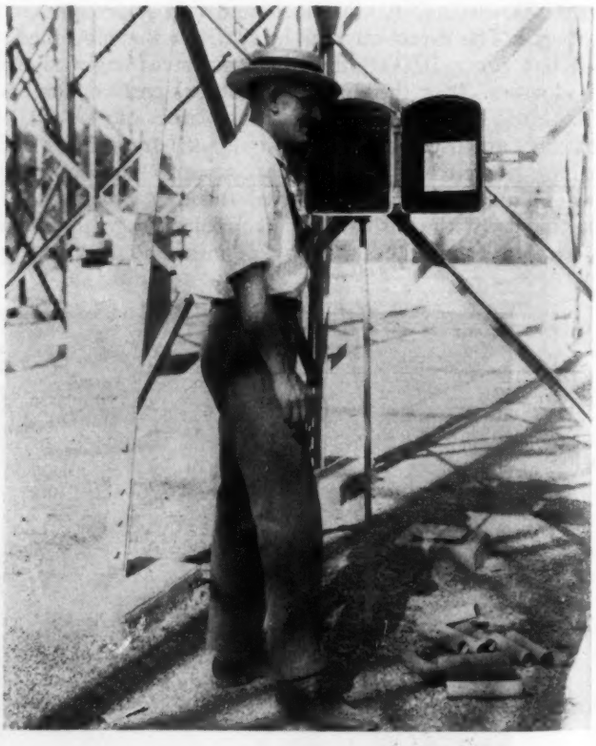
A RECENT addition to the list of power stations using high-pressure steam is that at Slite, Sweden, where a unit of 5,600-kw. capacity, designed for a maximum steam pressure of 890 lb. per square inch, has been installed. The steam is superheated to 750 deg. F. before entering the turbines. These are of the Ljungström double-rotation type and the high-pressure unit gives 1,400 kw., with a steam pressure reduction to 140 lb. per square inch.

Substation Yard Telephones Facilitate Dispatching

IN ITS new San Bernardino substation the Southern Sierras Power Company (Riverside, Cal.) has installed four yard telephones, which are used primarily to hasten switching operations, particularly where hand-operated switches are controlled by the yard man under orders of the switchboard operator. In clearing and grounding a circuit the yard man goes to the circuit terminus, opens the disconnecting switch, closes the grounding switch and reports the operation immediately by telephone, thus saving the time necessary to walk back to the building and climb two flights of stairs.

Other uses for the telephones will include getting in touch with the superintendent of the station in case he may be out in the yard inspecting work or equipment and in the over-all testing of metering equipment where the outdoor current and potential transformers are located at a considerable distance from the switchboard. In such testing the man in charge can communicate with his helper, thus avoiding the necessity of covering 200 to 300 ft. on foot. A Klaxon horn on the roof of the building, operated on code signal, informs the superintendent or others who are included in the code of such calls.

The telephones are Weston Electric mine phones, No. 1336 E, and cost an average of $152 each to install, including labor, material and overhead expense. The substation area is approximately 500x600 ft., with the



SUBSTATION SUPERINTENDENT ANSWERING CALL ON YARD TELEPHONE

four telephones located as follows: One in each end section of the 132-kv. bus, one centrally located with respect to the 88-kv. section of the station and one about the center of the 33-kv. bus structure. The average conduit run from the telephone switchboard in the station building to the yard telephones is 300 ft.

Fundamentals of
Public Utility Depreciation

Depreciation defined. Accrued depreciation, depreciation annuity and respects in which depreciation for accounting purposes and physical depreciation differ

By W. G. Cross
Assistant Valuation Engineer
Southern California Edison Company, Los Angeles, Cal.

It is the purpose of this and subsequent articles to simplify the subject of depreciation in a manner directly appealing to one who is engaged in public utility determinations; to point out from past experience some of the difficulties and dangers of attempting to use various methods of calculation, and to present some new and constructive phases of the matter. The author is assistant valuation engineer of the Southern California Edison Company and is well qualified to discuss the subject.

CONTRARY to what might be supposed from the great amount that has been written on depreciation, the determination of depreciation for a public utility is comparatively simple if the conditions surrounding the subject are clearly stated. The word "depreciation" is ordinarily very loosely defined and more loosely used. Any wear process or any experiencing of elapsed life is usually taken as depreciation, regardless of the fact that none may have occurred, appreciation possibly existing instead. Furthermore, there is a great deal of confusion among the items represented by the terms "accrued depreciation," "depreciation reserve," "yearly depreciation" and "depreciation annuity."

Depreciation herein is taken to be any lessening in worth due to wear and tear, loss in service value or special conditions affecting the continuance of use of the item, and covers both natural and functional depreciation. It should always be distinctly borne in mind that the accounting for depreciation is never depreciation itself and, in addition, it rarely represents the actual amount of depreciation accrued at any one time.

A discussion of the purpose of depreciation calculations indicates two general types of determinations—accrued depreciation and depreciation annuity.

A determination of accrued depreciation is desirable when dealing with a change in the financial structure of the utility, in order that the securities may be contrasted with the equivalent value, which in many cases is determined by computing the present-day cost less the accrued depreciation. Another necessity exists in producing a value for sale or condemnation purposes either where legal requirements demand that the accrued depreciation be deducted from the valuation figure or where an approximation to market value is being sought by using "cost to reproduce new, less depreciation." A determination of accrued depreciation is also necessary in the production of insurance valuations where the so-called "fair value" must be determined under the rules applied in determining insurable values and amounts of compensation in case of loss.

Determination of depreciation annuity is necessary, first, for the ordinary accounting purposes of a utility under the generally accepted practice approved by courts and regulatory commissions that the utility is entitled to progressive reimbursement of this original cost of property during the life of such items in order to compensate for the wearing-out process that takes place in the service of the public. This accounting annuity may be computed in various ways and does not necessarily reflect the amount of depreciation actually occurring in any one year. It merely works to the theory that at the end of the life of the item the utility will have been reimbursed for the full cost of that item under whatever method may have been utilized in setting up the reserve.

The determination of depreciation annuity is also necessary in rate proceedings before regulatory commissions and courts where the annuity is considered as an operating expense in determining the amount of net revenue that will probably be obtained by the utility under any given set of conditions. Almost without exception such an annuity is based upon original cost and is designed to reimburse the utility for its original expenditure at the end of the life of the property in a manner similar to the accounting determination previously described. A third reason for the determination of such annuity is for submission in income tax returns, and in certain cases the federal government may require a computation different from the ordinary accounting practice.

The fundamental bases upon which accrued depreciation is usually determined comprise proportionate elapsed life, proportionate consumed service units and actual measurement of wear and tear, such as corrosion, loss in insulating value, loss in weight or strength, change in surrounding conditions, etc. To express the bases more simply, they may be known respectively as "life table," "service unit" and "inspection" methods.

The determination of depreciation annuity is usually based upon the estimated life or the total estimated service method. The former uses commonly accepted "life tables"; the latter functions by estimating the total number of service units which the article can produce during life and dividing this by the estimated or actual yearly use. Determinations of actual accrued depreciation or actual yearly depreciation are useful to the plant engineers in determining the efficiency with which the various items will function, the length of time before it will be necessary to replace in service and the type of accompanying structures which it will be necessary to install or erect in order to have a complete installation composed of items of comparable lives.

On the other hand, the accounting depreciation annuity is useful to the financier and accountant in making sure that the wear and tear on the property, together with other forms of depreciation, is being adequately compensated for by yearly charges similar to operating expenses. Such determinations may follow the form of sinking fund accumulation, straight line accumulation or special payments to a reserve based upon some special financial conditions. The determination of the accumulation effected by these progressive depreciation annuities produces the figure in the depreciation reserve under whatever accounting basis may have been specified. This amount in the reserve is not necessarily a measure of the actual physical accrued depreciation and usually is very far from it, except under the most extraordinary conditions.

Facing the problem of determining what the actual depreciation of a property really is, we are confronted

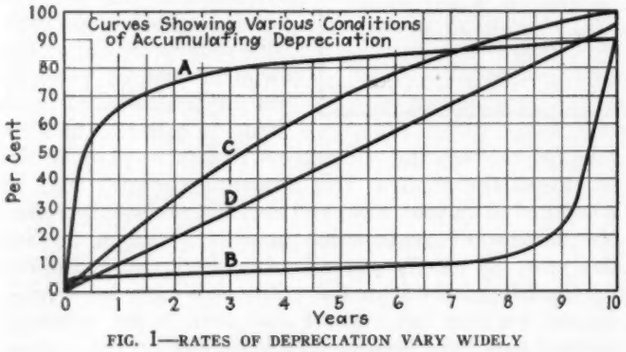


FIG. 1—RATES OF DEPRECIATION VARY WIDELY FOR DIFFERENT ARTICLES

Curve *A* represents the price depreciation of an automobile, Curve *B* the service value depreciation of a transformer, Curve *C* the depletion of an article such as a settling reservoir and Curve *D* the wear and decay depreciation of a wood pole.

by different definitions of depreciation, just as there are different definitions of the word "value." To explain briefly, instances of the latter may include depreciation in price, depreciation in number of remaining service units (such, for instance, as car-miles), depreciation in structural strength with corresponding diminution of safety, and depreciation in market value. Fortunately, the fundamental question involved usually gives the answer as to which type is needed. Personal judgment must then decide as to whether life table method, service unit method, inspection method or special determinations will best suit the subject in hand.

Life Table Depreciation

Foregoing for the present a discussion of the merits and disadvantages of the life table method, most engineers will admit that this is the method customarily used, mainly because of lack of other methods and data and because of ease of use. At least four possibilities then appear, these possibilities being indicated by the curves of Fig. 1.

Curve *A* represents an automobile, the resale price of which drops immediately after the car is placed in service. This curve of depreciation rises rapidly at the beginning of life of the item and is more or less uniform for the remainder, and would ordinarily apply to depreciation in price or market value.

Curve *B* represents a transformer when considered from the service angle. Regardless of its age, the transformer continues to perform its function without any

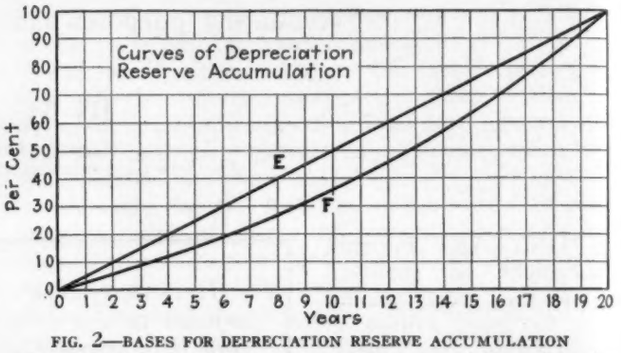


FIG. 2—BASES FOR DEPRECIATION RESERVE ACCUMULATION

Curve *E* shows straight line reserve accumulation when interest is not set up on payments. Curve *F* is the familiar sinking fund curve resulting from the payments being required to draw interest.

diminution in output and ordinarily with little increase in operating expense. Such a curve indicates almost no depreciation until the date of retirement and may be used to represent depreciation in service value.

Curve *C* represents the depreciation in an article such as a settling reservoir, the service of which consists in settling and accumulating sand and mud from the water in a canal line. This service depends, first, upon the capacity available to receive the mud, and second, upon the water capacity above the mud available for settling the flow. Such a curve, therefore, is a composite of two curves, one representing the lessening in storage space for mud and the other representing a constantly diminished settling value due to the decreasing water space. Such a curve may be used in determining depreciation on the basis of loss or depletion of capacity.

Curve *D* takes for its example the ordinary life of a wood pole, which is one of the few items of public utility construction actually believed to depreciate somewhat uniformly throughout life from the standpoint of market value and service value and, which, incidentally, is usually taken as an example when discussing depreciation, although obviously a special case. The curve is the familiar straight line curve and assumes a uniform loss in worth year by year.

From the financial or accounting point of view, the difficulties of so setting up the depreciation reserve or depreciation annuity as exactly to reflect actual yearly depreciation or accrued depreciation are so great as to be insuperable. An accountant must content himself with the building of a fund so that by the time the engineers decide to retire the item the fund will reimburse the utility for its original cost. The question as to whether interest shall be allowed to accumulate on the yearly increments to such a reserve depends upon a number of extraneous reasons, particularly the practice allowed by the regulating commission.

If interest is not set up on such payments, the accrual each year is usually a uniform amount and the accumu-

lation in the depreciation reserve follows a straight line from year to year. This is expressed by Curve *E* of Fig. 2. If the payments be required to draw interest, the yearly annuity is less than under the straight line basis, but the accumulation year by year is in the form of a constantly rising curve familiarly known as the sinking fund curve. This is represented by Curve *F*.

With this statement of the fundamentals of depreciation, subsequent articles will discuss individual phases of special interest.

Cost of Servicing Electric Ranges

By John T. Dysart
Kansas City Power & Light Company

ELECTRIC ranges provided with service by the Kansas City Power & Light Company reached a total of 2,533 during 1926. With such a large number of range users on its lines, the trouble department of this company kept an accurate record of the cost of servicing these ranges, grouped according to whether service was rendered gratis or whether a charge was necessary.

COST OF SERVICING ELECTRIC RANGES

Charge Service		
Revenue		$5,552.16
Cost of material	$3,141.94	
Salaries, customers' expense	1,263.06	4,405.00
Net profit on charge service		$1,147.16
Free Service		
Salaries	$4,637.75	
Cost of material	1,169.19	
Miscellaneous	843.43	
Total		$6,650.37
Net profit on charge service		1,147.16
Net cost for service—1926		$5,503.21
Net cost per month		548.60
Number of stoves connected		2,533
Cost per range connected		$2.17
Number of calls on 1,271 ranges		2,874
Cost per call		$1.91

Extension-Ladder Truck Aids Tree Trimming and Lamp Servicing

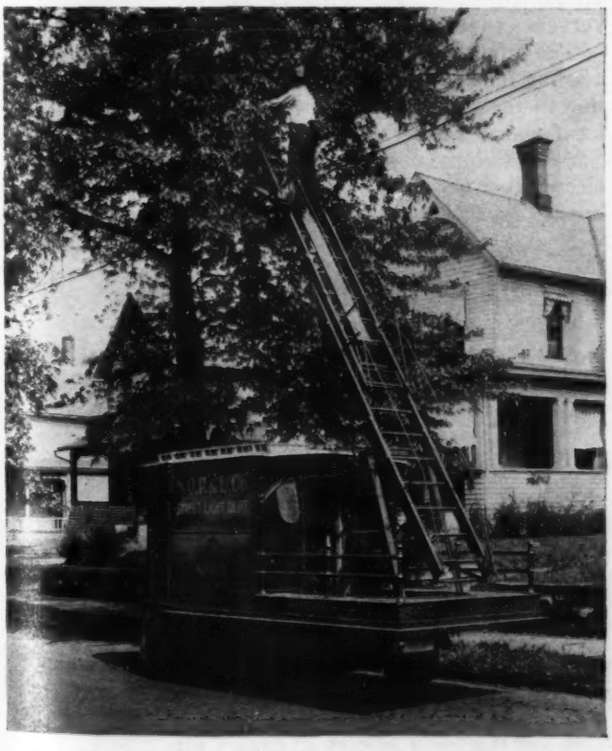
TO FACILITATE the servicing of street lights and at the same time provide a handy, portable extension ladder for tree-trimming work in its territory, the Northern Ohio Power & Light Company equipped a Model 18 Walker Electric chassis with an extension ladder as shown. The ladder was built by the Seagrave Corporation of Columbus, Ohio, at an approximate cost of $170 complete.

When it is in a horizontal position and fully extended it overhangs the side of the truck about 16 ft. The frame on which the ladder is mounted rests on a swivel and consequently may be swung around into any desired position. A street light can be serviced by a man standing either on the top of the truck cab or out on the pedestal at the side and rear of the body.

The truck body has a rear door with a full glass opening so that the driver has an unobstructed view to the rear. There is ample storage space in the truck body for repair parts and spare lamps and shades. A special tub is also provided for carrying washing water which can be heated by a coal-oil stove.

With this ladder equipment the trimmer can do the pruning required for clearance of the power lines without cutting off more tree branches than is absolutely necessary, inasmuch as the ladder can be so easily rotated into position to reach the points desired.

The ladder, as mounted at present, is raised or lowered by hand, but the hand-wheel control is to be replaced shortly by an electric motor operated from the truck battery. The ladder, the platform at its top and likewise the swivel on which the whole unit turns can be locked in any one of several positions by metal pins, which can be inserted in any one of a group of holes drilled at intervals in the quadrants of the circular supports.



LEFT—TRUCK AND LADDER IN POSITION FOR TREE TRIMMING. RIGHT—"WHITEWAY" LAMP POSTS ARE EASILY REACHED BY LADDER

Berlin Company Has Aggressive Sales Method

OPERATING statistics recently published in the annual report of the Berliner Städtische Elektrizitäts-werke A.-G., the corporation furnishing electrical energy to the German capital and its suburbs, indicate a rate of growth quite comparable to that of large urban systems in the United States. On a per capita basis, however, both installation and energy sales are decidedly lower than in similar American systems.

The load is evidently residential and commercial rather than industrial, although Berlin is becoming an important manufacturing center. That fact is being stressed in the company's publicity campaigns. Less than half the energy is sold at wholesale and there is a pronounced evening peak. Some data taken from the report are given in the table:

	December Count or Yearly Total 1926	1925	Per Cent Increase
Connected load, low-tension, kw	555,698	516,915	7.50
Connected load, high-tension, kw	243,612	222,771	9.37
Connected load, public lighting, kw	1,893	1,731	9.35
Connected load, total, kw	801,203	741,417	8.06
Meters, low-tension customer	474,052	399,945	18.50
Customers, low-tension	442,044	368,706	19.85
Meter installations, high-tension	755	672	12.35
Customers, high-tension	564	499	13.01
Dwellings in city and suburbs	1,169,933	.....	.....
Dwellings electrically lighted	320,153	.....	.....
Per cent electrically lighted	27.37	.....	.....
Installed capacity, owned and leased, kw	314,850	281,500	11.83
Generated and purchased energy, kw.-hr	832,498,285	775,645,920	7.34
Annual load factor	30.2	31.5	.....
Energy sold, kw.-hr	705,126,941	651,939,539	8.16
Population served	3,621,200	3,558,605	1.76
Kilowatt-hour sales per capita	194.72	183.20	6.29
System peak, kw	299,500	258,000	16.10
Energy sold at wholesale, kw.-hr	322,045,009	314,619,146	2.36

Dilution of per-customer consumption seems to be a world-wide phenomenon; the increase of nearly 20 per cent in number of low-tension customers, with only a 7.5 per cent increase in the corresponding load, indicates that this problem confronts the Berlin company as it confronts many in other cities.

The company's relations with wiring contractors are novel. Installations to be connected to the company's lines may be made only by approved firms. These at the close of the year numbered 2,850. Approval is based on examination, which apparently includes a practical test of the applicant's craftsmanship.

Demonstrated lack of reliability is followed by cancellation of approval previously given. A number of instances of this occurred during the year. To increase the energy consumption customers are assisted by the company through a subsidiary organization in the purchase of appliances and in paying for new installations. The customer pays a certain percentage down and gives the company security for subsequent monthly installments; the company advances the balance to the appliance dealer or wiring contractor, and collects from the customer, adding 5 per cent for final payment in five months, or 10 per cent for ten months. Only approved appliances are thus financed.

Advertising and publicity methods are ingenious, diversified and apparently fully abreast of the best American practice. Catchy inclosure with bills, attractive newspaper copy, illuminated outdoor signs and several display places, including a "home electric" near the city's chief amusement park, are among the devices utilized.

Adapting Farm Application Displays to Territory

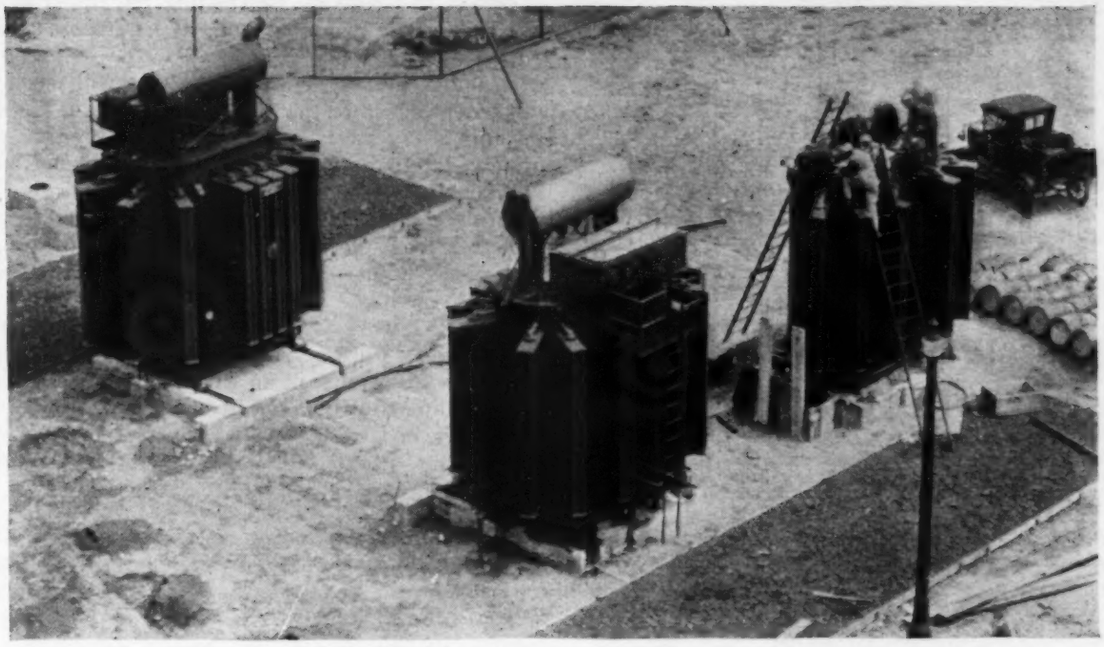
By Richard Boonstra
Agricultural Engineer Public Service Company of Northern Illinois

THE problem of educating farmers to use electricity for other than household purposes must be solved locally, because of the variety of agricultural products raised in each territory. Therefore it is necessary to exhibit electrical appliances particularly adaptable to the kind of farming practiced in each community. The illustrations indicate how this is being done by the Public Service Company of Northern Illinois.

One view shows the application of electricity to chick raising, exhibited in a poultry-raising community. The electric brooder takes care of 200 chicks, treated with ultra-violet rays from a Cooper-Hewitt Univarc lamp. An experienced poultry man, popular and well known in the community, was on hand to advise on all problems connected with the raising of poultry. Interested observers crowded this exhibit throughout each day.

The other view shows a county fair exhibit in a dairy-feeding territory. The success of this display was largely due to the popularity of the implement dealers and one local dairy farmer who co-operated with the Public Service Company in exhibiting machinery operated by electricity. Co-operating with local dealers in this work creates good will and adds a substantial electrical load.

EXHIBIT OF ULTRA-VIOLET TREATMENT IN CHICK RAISING AND ELECTRICAL DISPLAY AT COUNTY FAIR APPEALED TO ILLINOIS DAIRY-FEEDING FARMERS



FEEDER-TRANSFORMER UNITS HAVING NO EXPOSED BUSSING OR SWITCHING FACILITIES AND REQUIRING NO OVERHEAD STRUCTURES

Serving Large Power Blocks

with 24-Kv. Feeders

Limitations of 13.8-kv. system dictate use of higher voltage feeders. Simplification of substation design and improved testing arrangements are achieved

By Wellen H. Colburn

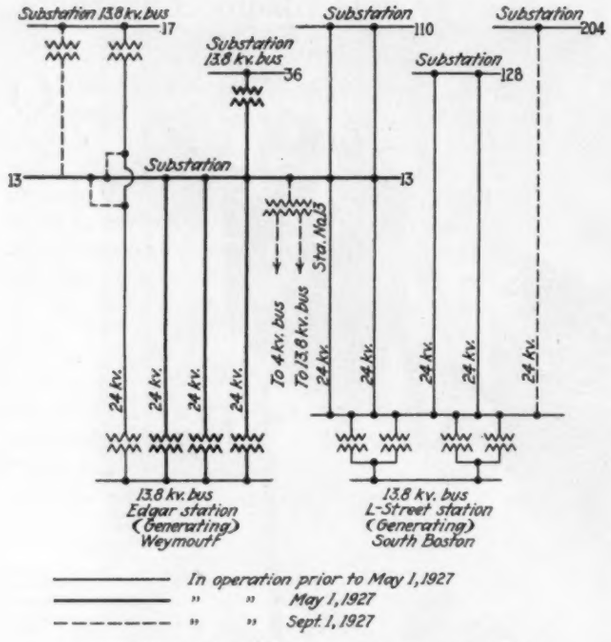
Electrical Engineer Edison Electric Illuminating Company of Boston

THE growth of power requirements in the territory of the Edison Electric Illuminating Company of Boston and the installation of a new 75,000-kva. generating unit recently brought to the fore the problem of the economical transmission and handling of larger blocks of power from the Charles Leavitt Edgar station than was possible with the existing 13.8-kv. cable system. The initial solution of this general problem is comprised in the installation of a section of a 110-kv. transmission ring, now nearing completion, which eventually will surround the Boston territory. In the study of the situation there was considered a further development of the present 13.8-kv. system requiring an extension of the Edgar station switch house, the development of group bus operation in small and relatively cheap substation type structures in the station yard and transmission at some voltage intermediate between the generated pressure of 13.8 kv. and that of the 110-kv. ring.

The solution of this part of the problem was hastened by needed repairs to two turbo-generator units at the L Street station, which, with the existing system load, made it imperative to deliver a large block of power from the Edgar station to the center of the metropolitan territory early last spring. Toward the end of 1926 it was determined after intensive study to meet the need by the development of a 24-kv. transmission system. The selection of this voltage was dictated by interconnection with individual lines of this pressure of some years standing, over which power is supplied to the New England Power Company and the Tenney company systems.

As soon as this was determined, drawings for the generating and substation work were begun, orders for material already selected closed, contracts prepared and construction orders placed almost over night. Thanks to the hearty co-operation of manufacturers and contractors, the new 24-kv. system went into operation on the scheduled date of April 1.

The system as put into operation is shown by the light and heavy lines in the accompanying one-line diagram and as it was in September, 1927, by the dotted lines. The light lines show the previously operating 24-kv. transmission lines, two each from the L Street gener-



DEVELOPMENT OF 24-KV. SYSTEM FOR HANDLING LARGE BLOCKS OF POWER

ating station to the New England Power Company and the Eastern Massachusetts Electric Company, and one from the Edgar generating station to the Newton substation (No. 17). At the Baker Street station (No. 110) voltage is stepped up to 66 kv. for connection with the New England Power Company system. The heavy lines represent the extensions and interconnections put into operation last spring and consist of three transmission lines from the Edgar station to the Roslindale substation (No. 13) and one from Roslindale to the Allston substation (No. 36), and looping the former New England Power Company's lines into Roslindale. The dotted lines show the additional connections that were put in operation recently, including an additional line to the Newton substation (No. 17), a three-winding transformer and the looping of the old Edgar station to Newton line in and out of Roslindale.

The system ultimately contemplates twelve 24-kv. lines out of the Edgar station with a switching station established at Roslindale. If found advisable, a second center will be established later elsewhere. From these distributing points lines radiate to the company's distribution stations or interconnect with other utilities. At the company's L Street generating station it is also possible to make a tie connection to a 24-kv. cable system now supplying power to the Tenney company system.

Bus and Transformer Structures Omitted

During a study of the economics of this higher voltage system over that of the 13.8-kv. transmission previously used it became evident that neither the saving in core losses nor additional operating flexibility could justify any arrangement providing bussing and switching of the transformers and lines with the structures and equipment required therefor. From the standpoint of cost as well as of appearance it was desirable to eliminate all structures at the transformers if possible. The development of the industrial type of pothead and its satisfactory use by this company on both high and low-tension sides of its station transformers indicated that all structures could be eliminated. Such an arrangement offered another advantage in that it would permit simplicity in operation and relaying by treating the transformer and line as a single operating unit, as heretofore done with the 13.8-kv. lines.

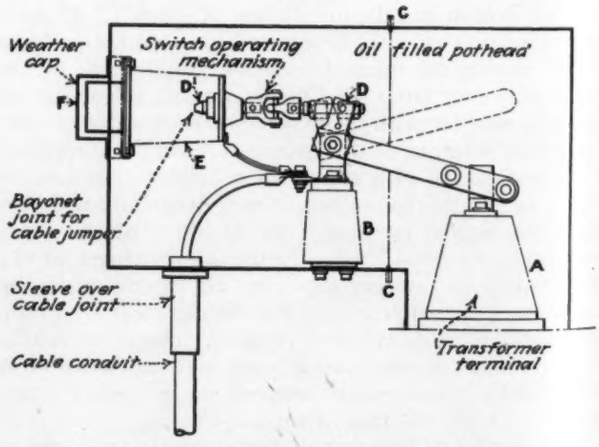
A study of the operating problems with such an arrangement indicated that difficulties would be met in testing the 24-kv. cables. In order to apply either phasing or fault-locating current or to make acceptance and routine kenotron tests it would be necessary to drain the oil from the pothead, open it to the weather and disconnect the cable from the transformer. Besides the delay and inconvience thus encountered, it was foreseen that weather conditions here near the seacoast might easily prohibit such work for several days, even though the tests were urgent. Further, suitably to insulate tests pressures of 120 kv. to ground in an empty pothead promised additional difficulties and inconveniences in properly supporting the ends of the cable conductors and by requiring refilling the pothead with oil during test.

Special Disconnecting Facilities

After some study in co-operation with the transformer manufacturer, disconnecting switches with operating mechanism and arrangements for external connections either to the cable or to the transformer windings were incorporated in the oil-filled industrial type pothead to meet this condition.

The transformer terminals *A* in the pothead are fitted with switch clips instead of with the usual terminal lugs. Pillar insulators *B* supporting the heels of the disconnecting switches are mounted in that part of the pothead which is attached to the cables, the pothead being split at *C* so that if the transformer has to be removed for repairs it can be rolled away without disturbing the connecting cables. The pothead can then be capped and filled in order to keep the cables sealed under oil, or another transformer can be put in place on the same pothead. The disconnecting switches are opened and closed by means of a screw and nut *D* operated by an insulated key which is inserted through an insulating bushing *E* in the side of the pothead to engage the screw.

The end D^1 of the screw extending out through the stuffing box in the bushing has a taper and a locking pin conforming to the standard bayonet points used by this company in connection with cable jumpers on disconnecting switches. By means of these bayonet points and suitable cable jumpers connections between the low and high-tension cables can be made for phasing or fault locating, or high potential and kenotron tests can be

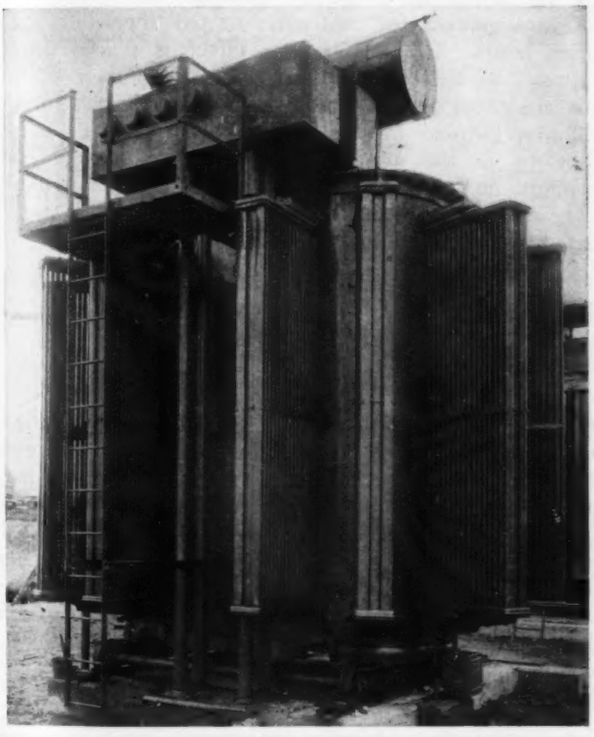


POTHEAD DESIGNED TO FACILITATE GROUNDING OF NEUTRAL, DISCONNECTING OF HIGH AND LOW-TENSION WINDINGS AND FIELD TESTING

applied. In order to insulate properly for the kenotron cable tests all of the insulators and bushings in the pothead are designed for the maximum permissible cable acceptance test of 120 kv. direct current to ground. When in use, the external portion of the bushings in the pothead is protected from the weather by a cap *F*.. This disconnecting switch equipment is provided on all terminals of both high and low-tension windings, including the neutral, except on the low-tension side of the transformers at Allston and Newton, where the transformers are close to the stations.

Aside from the recognized safety advantages obtained by the use of the industrial type pothead, this arrangement provides a large saving in cost by providing:

1. Grounding of the 24-kv. neutral through a disconnecting switch in the pothead and without the expense of a structure.



NEUTRAL GROUNDING, DISCONNECTING AND TESTING FACILITIES ORDINARILY REQUIRING OVERHEAD STRUCTURE ARE PROVIDED IN OIL-FILLED POTHEAD OVER TRANSFORMER

2. Means for disconnecting both the low and the high-tension cables from the windings without the expense of a structure.

3. Means for attaching connections from the kenotron to the cables without an expensive structure, test bus and disconnecting switch equipment.

4. Means for making phasing current connections over the low-tension cables to the high-tension cables from reference points in the switch house under the observation of the station operator without the cost of test cables with their ducts and the structure, test bus and equipment as noted.

5. Means for making fault location connection over the low-tension to the high-tension cables from equipment in the switch house now used for such tests on 13.8-kv. cables. This equipment includes a high-tension bridge and Lundin fault locater for burning down and locating faults.

6. Opportunity to apply a high potential or other test to the transformer windings should be advanced in the company's testing program.

7. A neat, simple and inconspicuous arrangement providing a maximum of power transmission at a minimum of outlay.

8. Simplicity and standardization of operation and protection, as these lines are from these standpoints no different from 13.8-kv. lines leaving this station.

9. Low maintenance as the result of simplicity of arrangement and operation, lack of structures and outdoor apparatus to paint and maintain in operating condition where subject to coastal air.

Each transformer unit is of General Electric manufacture, rated at 12,000 kva., self-cooled. The low-tension connections consist of two three-conductor, 350,000-circ.mil, 15-kv. paper and lead cables. The high-tension connection is the same size three-conductor cable insulated for 28 kv. All are wiped onto the pothead. The transformer neutral is brought out also with a lead-covered cable sealed in. These leads are all completely inclosed in conduits from the ground up to the pothead. Temperature-coil connections and equipment using the alternating-current bridge method developed by this manufacturer are also provided to permit supervision from the switch house of three of the transformer coils in each unit.

It is too early to draw conclusions from experience with this equipment, but it went into service successfully and has been operating so far with complete satisfaction.

Municipal Electric Pumping Gaining in Favor

A DECIDED trend toward the more general use of electric pumping for municipal water supply service was brought out at a recent convention of the New England Water Works Association at Boston in a paper by R. C. Dennett and George L. Swan of the National Board of Fire Underwriters and in discussions in which prominent water-supply engineers participated. Messrs. Dennett and Swan pointed out that the interconnection of electrical supply systems has increased the reliability of central-station service to a point of almost perfect dependability so far as the source of energy is concerned, but that reserve in the form of elevated water storage or other power units is still essential in many cases on account of the importance of maintaining pressure during fires that occur at times when transmission lines are temporarily interrupted. When possible, this elevated storage should be able to meet the demand for water over a period of at least 30 to 60 minutes.

The most economical and dependable form of reserve equipment is the gasoline-driven pumping unit, in the authors' opinion. Although this is limited in capacity, reliability gains by the use of a number of small units, such as six of 1,000,000 gal. per day capacity compared with two 3,000,000-gal. units. The Diesel engine is satisfactory as a stand-by unit, but on account of its high first cost is not favorably looked upon for very infrequent operation by water-works officials. Regarding electrical supply, the authors advised the installation of duplicate underground lines where feasible, each traversing a separate route to the water-works station from an independent generating station. In any case, two inde-

pendent circuits should be provided and attention given to the reliability factor in the operation of switching and transformer installations.

The increase in the use of electric drive for pumping apparatus has coincided with improvement in the design of electric motors, which now have a reliability equaling or exceeding steam engines. Periodic inspections of motor installations, however, should not be overlooked in the increasing use of automatic and remote-controlled outfits. For constant-speed work synchronous motors are now as reliable as those of the induction type, but adequate starting apparatus is essential and should enable installations to get under way even with two units out of service. Transformers should be so located as to insure that no interruptions shall occur to the pumping service in case of fires in the former. Within the last two years a fire in a transformer located in a Southern city under the windows of the generating station resulted in the wetting of the switchboard and other apparatus by the fire department, shutting down electrically driven pumps and leaving the city without water for several hours until the equipment could be dried out.

Allen Hazen, consulting engineer, New York, stated that the claims of pump manufacturers on behalf of the general use of synchronous motors are mistaken. Unless the load is constant, the induction motor should be used. Electricity has become more reliable with the passing years.

In a discussion of a paper by A. O. Doane, W. W. Brush, New York, stated that the trend is toward the electric drive in the New York district. Where there has been a difference of not more than 5 or 10 per cent in operating cost, electricity has been selected instead of steam. In Manhattan, at the 79th Street pumping station, where electric drive is about to go in, the cost per kilowatt-hour worked out about 1.1 to 1.2 cents. The costs were about the same for electricity, steam pumping and Diesel engine service. Since 1907 the high-pressure system in Manhattan has been electrically driven without a failure of electrical supply. The service is furnished by three or four independent cables interconnected with six generating stations, and a penalty of $500 a minute is provided in case of service failure.

Paying Bills After Office Hours

IMPORTANT

Use these envelopes in paying your bills if cashier's department is closed. Insert your money or check with bill and seal.
Your receipt will be mailed to you the following day.

Usate queste buste per pagare i vostri conti se il Dipartimento dei Cassieri e' chiuso. Mettetevi dentro il danaro od il check e chiudetele. La ricevuta vi sara' mandata per posta il giorno seguente.

Używajcie dane kopertki przy płaceniu waszych zaległości (bilów).
Włóżcie do kopertki pieniądze lub czek za zaległość i zalepcie. Włóżcie także bil, który wam był nadesłany.
Pokwitowanie będzie wam odesłane przez pocztę na drugi dzień.

THE Utica Gas & Electric Company has a convenient arrangement for customers to pay their bills after office hours. A mail box in effect is placed in the entrance of the office building. In a container on this box are envelopes in which the money or check for the bill may be placed, after which the customer drops the envelope in the mail box. On the outside of each envelope instructions are written in three languages. This service has been used freely and is much appreciated by customers of the company.

Decorative Lighting Greeted Legionaires at Paris

ONE of the McGraw-Hill American Legion men, just returned from Paris, brings back this example of the decorative lighting that adorned store fronts, public buildings, fountains and monuments in the French capital, during the visit of fifteen or twenty thousand American Legionaires recently. Most of the decorations involved illuminated flags or representations of flags. Strings and arches of lamps formed festoons along curbs and over streets and boulevards, particularly on the Champs Elysées from the Arc de Triomphe to the Place de la Concorde.

A SAMPLE OF STORE-FRONT LIGHTING DURING AMERICAN LEGION SOJOURN IN PARIS

Survey Proves Value of Red Seal Plan

California Electrical Bureau analyzes wiring in 500 homes. Red Seal homes use 429 kw.-hr. monthly

By Victor W. Hartley
Executive Secretary California Electrical Bureau, San Francisco, Cal.

WHAT is the true value of the Red Seal plan as a market development program? That is a question of prime interest concerning the plan, yet it has remained unanswered up to the present time. Skeptics have been prone to divide budgets by the total number of Red Seal homes acquired and ask if the unit cost per home was not prohibitively high. Those who have been thoroughly sold on the value of the Red Seal plan have retaliated by stating that for every home in which the Red Seal standards are complied with, from five to ten others have been contacted and these contacts have resulted in material increases in electrical installations. Now all need for generalizing and theorizing has been removed. Surveys recently completed by the California Electrical Bureau, an organization to bring about cooperation among all branches of the industry, present the facts which all may study.

Three-Class Survey

The survey included about 500 homes. A report made for each home provided data as to the number of lighting outlets, switch outlets and convenience outlets; the size of service conduit, wire and switch, and the number of lighting outlet and convenience outlet circuits, as well as showing which homes are equipped with range service, water-heater service and air-heater service. These reports were divided into three classifications: Class 1, those homes on which no Red Seal effort had been made; Class 2, those homes on which Red Seal effort was made but which was unsuccessful, and Class 3, those homes wired up to Red Seal standards. The result was a true picture of the type of electrical installation representative of the average in each classification. The more important items are as follows:

	Class 1 Homes	Class 2 Homes	Class 3 Homes
Lighting outlets	14.4	33.4	32.8
Convenience outlets	8.7	21.2	20.1
Switch outlets	13.1	18.5	20.9
Lighting circuits	2.2	4.1	5.0
Convenience outlet circuits	1.0	2.9	3.5

The total of branch circuit outlets in the Class 2 average is 73.1; the total in the Class 3 is 73.8; the total in the Class 1 is 36.2. No homes in Class 1 were wired for air heating, whereas 49 per cent of the Class 2 homes and 46 per cent of the Class 3 homes were equipped with either installed wall-type heaters or heater circuits and outlets. No homes in Class 1 were wired for water heaters, whereas 1 per cent of the Class 2 and 43.3 per cent of the Class 3 homes had water-heater provision. In so far as ranges are concerned, only 0.9 per cent of the Class 1 homes were wired with range service, whereas in the Class 2 homes 3.1 per cent and the Class 3 homes 100 per cent were so equipped.

Another very interesting point is brought out by a study of the figures regarding main services. In the Class 1 homes 95.6 per cent were equipped with ¾-in. conduit, and 87.8 per cent had two No. 10 wires. Because of the ¾-in. conduit these homes offer little market for future load-building programs. In the Class 2 homes 86.2 per cent were equipped with 1½-in. conduit, and although 95.7 per cent had only three No. 10 wires serving them, the 1½-in. conduit will permit replacing these No. 10 wires with as large as No. 2 or No. 1 wires at a minimum cost at a future date when the load-building programs of the power companies make such a change desirable. In the Class 3 homes the conduit sizes are 1¼ in., 1½ in. and 2 in., carrying wires varying in size from three No. 4 to three No. 3/0.

In one tract of 285 homes Red Seal effort has resulted in an increase of 6,140 branch circuit outlets, the increasing of the service conduit from ¾ in. to 1½ in. and the addition of a 1-kw. air heater in every bathroom.

Figures taken from the power companies' records as to the energy consumption in approximately 150 Red Seal homes which have now been occupied for a year or more show an average monthly consumption of 429 kw.-hr.

Further comment on these figures should be unnecessary. They tell their own story to anyone in the electrical industry regardless of the branch he may be in, and summarized they seem unquestionably to prove that the Red Seal plan is a true solution to the great problem, How can we sell better wiring jobs, more appliances and more kilowatt-hours?

Letters from Our Readers

Claims Service Should Be Measure of Return on Investment

To the Editor of the Electrical World:

Much time and thought have been devoted to the consideration of how the electric utility can attract a larger portion of the family budget. Every one concedes that there is no reason why householders should not use more electricity. Many companies have made active efforts to increase their revenue by bringing about greater use of their product. Inducement rates, intensive sales and merchandising campaigns have been repeatedly tried with this end in view. On the other hand, some utility companies have been content to charge flat rates for residential service and have been less active in efforts to encourage a wider and more extensive application of electricity in the household or commercially. Both classes of utilities, however, are permitted to earn a "reasonable return," say the courts. This "reasonable return" is adjudged to be about the same for all electric utilities.

Investors in the type of utility which makes active efforts to increase its revenue by inducement rates and intensive sales efforts are not in a much better position, if in any better position at all, than investors in the type of company which does not actively endeavor to promote greater use. The customers of the former type of company are, however, better served than are those of the latter class. What incentive, then, exists for an electric utility to enter upon a progressive campaign calling for the introduction of an inducement rate, intensive selling or some other such plan? First, there is the attendant

risk than an inducement-rate form will not increase use to such a degree as to offset the cut in rates. There is also the additional risk that the larger new-business expense will prevent the revenue being sufficient to make the venture profitable. Should the progressive policy prove successful, the "reasonable return" will be exceeded, and then the utility will be exposed to the charge that the public is being exploited and that the earnings are unwarranted and excessive. Accordingly, say the "spokesmen" for the public, rates should be further reduced to the "reasonable return" level. As a matter of fact, the public will be getting more for its money and its satisfaction will be expressed by the increased use and greater gross payment per customer. Should the rates be reduced to a "reasonable return," this company will be in no better position than its less active neighbor. What, then, I ask again, aside perhaps from the better public relations which may or may not result, does it benefit a utility to effect economies and improvement in service and use, when it is bound by the same fetters as its sluggish neighbor?

The lack of a commensurate reward for economies given to the public appears to be the principal, if not the only, factor retarding growth in the industry. An incentive scheme, allowing or even encouraging a utility to realize as much profit as it is legitimately able to earn, provided that its consumers are served at a low cost, would surely alter this condition and provide a more healthy stimulus to greater economies and higher efficiency than now exist. Public, investors and management alike would benefit. The difficulty lies in the determination of a standard by which performance could be judged. The varying characteristics in different communities and among different companies, which will necessarily result in varying costs of service, make this problem rather formidable. While it is virtually impossible to advance a solution that will permit of easy and ready application, it is possible that continued thought in this direction might evolve something which would, in a measure at least, accomplish the desired end—to reward efficiency and progress with their just due.

Pelham Manor, N. Y. JOHN F. DUFFY.

[What easily usable yardstick can commissions use to determine the relative degrees of progressiveness of companies, if they decide that the return on investments should be proportional to progressiveness? Possibly, if progressive utilities could collectively develop a basis of measurement, public service commissions would be glad to recognize it.—EDITORS.]

Opportunity to Exemplify Spirit of America

To the Editor of the ELECTRICAL WORLD:

I have read with much interest the letter on page 168 of the ELECTRICAL WORLD for July 23 by "A Young Engineer," under the heading "Asks Sage Advice on Three Subjects." The writer, referring to the Harvard Business Alumni Association Bulletin, finds that public utility employees stand the lowest in rates of compensation. This is certainly a most important and to many a surprising statement. For, while some work such as electric meter "engineering" has long been known for its low-wage scale, it comes somewhat as a shock to hear that the central-station employees as a whole are afflicted with the dry rot of financial stagnation. If it be true, it discloses an unfortunate condition in one of the largest and perhaps the most interesting and useful of American industries, one which, by all rights and expectations, should stand near the head and not at the foot of the list in regard to compensation to employees.

As for the average employee, the workingman's "budget" (family of five) is placed at $2,124 per year by government statistics, but the average wage of the central-station "workingman" is completely outclassed by such a figure. A foreigner, with limited education and training and holding more or less "radical" views, may come to New York and in a few months or a year be earning from $35 to $50 per week. On the other hand, American boys with public school training and American ideals may work for an American electric light corporation from one to twenty years and receive from $25 to $40 per week. Which employee will have the better family?

Mergers, increased stock values and holding companies are quite right and necessary to such an extensive and rapidly growing industry, but to the poorly paid employee and his family such prosperity serves only to emphasize his lack. Not that he necessarily entertains "radical" ideas, but that it is impressed upon him that some things might be better "arranged" in this good old U. S. A. He wonders whether, after all, it is really good American "business sense" to pay indifferent wages to American employees in the American public service industry that in so many other ways expresses the "spirit of America." Wherever there is an American public service company there should be a center for American ideals, expressing fair dealing, expert service and right-thinking attitude. What a power for good every electric light corporation could become, a real constructive force for upbuilding the community and our whole country, if "liberally fair wages" and "good will" were practiced! It is now generally conceded that "righteousness is scientifically correct." And it must be remembered that our workers should be enabled to provide properly for their families and that the American home should be encouraged rather than made more difficult to establish and maintain.

One of our greatest captains of industry, the late Judge Gary, glimpsed something of the truth of righteousness when, after the change in the steel industry from a twelve-hour to an eight-hour day, he saw the business grow beyond all expectations. He said: "The leading men of the steel corporation who have survived all believe, I think, that to pay your employees liberally fair wages, to give them accommodations, protection, safety appliances and methods, is money in your pocket—in the long run, I mean. I remember how big business used to tyrannize over its men—just as it used to drive smaller, weaker institutions to the wall. We don't do that now." Some time ago the Judge was asked what gave him the greatest satisfaction in his whole life's work. "I would say," he answered, "that it has been securing the friendship and confidence of the large majority of our great family of employees."

We have many honestly capable leaders in the central-station industry. Our electric light corporations are in a particularly favorable position to pay all of their employees "liberally fair wages," for electric light rates are now so fair that, with the public approving through the public utility commissions of a reasonable delay in a further reduction of rates, an immediate step to this end could be taken, without harm to any one and with much good to the great army of faithful employees and their families. OLD TIMER.

Digest of Electrical Literature

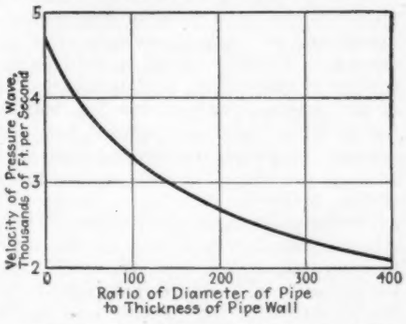
Generation, Control, Switching and Protection

New High-Voltage Leads.—J. WALLICH.—A new type of outdoor high-voltage leads for 45, 60 and 100-kv. service which consists of two concentric tubular porcelains, the outer one with the conventional petticoats, has been developed. The relatively small clearance between the surfaces of the inner and outer portions is filled with a cement with an expansion coefficient the same as that of porcelain. Flash-over tests made with commercial frequency and with impulse frequency for dry and wet condition indicate that the 60-kv. type arcs over when dry at 185 kv. and when wet at 170 kv. The same lead flashed over at 365 kv. under an impulse test. It is claimed that this new type of lead is simpler, cleaner and cheaper than the equivalent oil-filled construction.—*Elektrotechnik und Maschinenbau,* Sept. 11, 1927.

Switchgear for Alternating Current.—H. W. CLOTHIER.—In reviewing the general characteristics of the switching apparatus used in various countries, the author has reached the conclusion that the continental switchgear is generally light, with somewhat scanty protection; that American policy has taken its power-station switchgear to extremes in protection, and that British designs on the whole tend toward stronger circuit breakers. The latter practice leads to a reduced expenditure for buildings by making the switchgear form a complete unit entirely contained within a strong metal inclosure. Such devices afford a construction in which none but grounded metal can be touched and risks of fatal shock are minimized. The economy which may be effected in design and construction is pointed out for the furtherance of the endeavor to produce less costly control switching apparatus. An effort has been made to express the fundamental nature of the problems involved.—*Electrical Review (England),* Sept. 9, 1927.

Hydro-Electric Development and Steam Equipment

Effect of Speed Regulation and Water Hammer on the Design of Relief Valves, Penstocks and Surge Tanks.—This study gives a brief review of the generally accepted formulas for speed regulation and details of the various theories of water hammer and their limitations. Both formulas and theories affect and are affected by the design of the penstocks, relief valves and surge tanks used in modern medium or high-head hydro-electric developments. The study is a part of the report of the hydraulic power committee of the Pacific Coast Electrical Association, and it has therefore been largely limited to the practice followed by the member companies of that organization. In considering the phenomenon of water hammer, a résumé of previous investigations is given and the subject is approached through the theory of the elastic water column and the assumptions underlying general equations, involving friction in the pipe line, varying diameter and thickness of the same, and partial reflection of pressure waves at the valve. Approximate formulas and their limitations are indicated. The effect upon valve design has been investigated in connection with relief valves and deflectors for tangential wheels and reaction turbines and the operation of such valves. The effect upon the design of penstocks involves acceleration of flow and pressure drop in them, and this has been duly considered. Surge-tank design as affected



VELOCITY OF PRESSURE WAVE IN ELASTIC WATER COLUMNS

by the properties of pressure conduit between reservoir or forebay and tank and water hammer or pressure rise when closing turbine gates, acceleration of flow and action of the governor have all been developed. Definite practices in the more usual types of installations of surge tanks are tabulated and illustrated. — *National Electric Light Association report,* August, 1927.

Hydraulic Accumulation. — L. REICHARD.—Some twelve hydro-electric plants in Europe utilize hydraulic accumulation to good advantage to cover their short peak-load period. In these stations surplus power is used to drive motor-operated spiral pumps which deliver water into a lake high above the power house. During the peak-load demand the water returns and generates additional power. The paper gives installation and operating costs of such a plant of 21,000 hp. capacity. While the over-all efficiency of this type of installation is usually only about 55 per cent, the economies from a strictly peak-load-supply standpoint are very considerable. The yearly maintenance cost is placed at only 9 per cent on the investment. The reserve power is available at any moment within less than two minutes, with absolutely guaranteed reliability.—*Siemens Zeitschrift,* June, 1927.

Transmission, Substations and Distribution

Electrical Calculating Chart. — D. HORACE JONES MORRISTON.—A short-cut diagrammatic device for solving power problems for direct current and single and three-phase alternating-current circuits is offered. The relation between power factor, voltage, kilowatts, horsepower, amperes and efficiency has been correlated for rapid calculations by means of a chart which may be utilized by employing a straight edge in conjunction with the values on several scales and certain arbitrary reference lines. — *Electrical Review (England),* Aug. 19, 1927.

Changing of Tappings on Loaded Transformers.—It is stated that while British electrical engineers realize that when necessary to change the voltage of transformers under load the tap changing method is the cheapest one that can be adopted, the design of such apparatus has not been pushed in Great Britain. What are believed to be the first transformers to be controlled by this system have recently been placed in operation. The installation consists of three 12,000-kva. transformer banks, with a ratio of 10,500/22,000 volts. The windings are connected in delta-star and the voltage ratio is changed under load, to offer a boost of 8 per cent in steps of 2 per cent. On the 22,000-kv. side there are double, parallel-connected windings, so that normally each winding carries half the total current. When it is desired to change the voltage ratio, the circuit of one of the windings is opened by means of a quick-break oil switch, called a series switch. The taps on this winding are then changed and the total load current is carried during the very short period of time required for this operation by the other winding. The series switch is then closed again, when the same operation is performed by another series switch on the other primary winding. By correct operation of the series and tapping switches in the proper sequence the voltage is changed without interrupting the supply to the system. This installation is designed for electrical control from a distance, and as the transformers operate in parallel the control gear has been designed so that the three banks of transformers can be regulated with one controller. Automatic operation can be provided, but in the case of this first installation it was not called for in the specifications. Provision against failure of the auxiliary supply to complete a full movement of the tap changer, thus overloading a portion of the winding, includes differential current transformers in the parallel connections of each side. The secondaries of these transformers are connected to a relay having a time lag sufficient to prevent operation during the normal working of

the tap changer. The relay can be arranged to give an alarm and to trip one or both of the main transformer switches. The time taken for the gear to give a change of voltage, measured from the instant that the control switch is closed to the moment of a completion of a voltage step, is less than two seconds, while measured from the time of opening of one series switch and the closing of the second switch it is less than one second.—*Engineer (England)*, Aug. 26, 1927.

Heat Applications and Material Handling

Fused Quartz.—H. GEORGE.—This article describes the process of fusing quartz in the electric furnace and the commercial manufacture of articles made from this material. The author confines his treatment exclusively to the methods and the progress of the art in France. Much information is given on the various furnaces used, such as resistance, arc and high-frequency types; the melting process is minutely described, and finally the finishing or machining of the articles is explained. The last chapter gives examples of practical applications of fused quartz for chemical, decorative, optical and electrical purposes. The use of quartz for high-voltage insulators and vacuum tubes is of particular interest.—*Revue Générale de l'Electricité*, July 23 and 30, 1927.

Domestic Water Heating.—JOHN H. PARKER.—The author claims that at 2 cents per kilowatt-hour electric domestic water heating can be a commercial proposition in Great Britain. It is stated that the reasonable way to provide hot water is to install properly lagged water heaters, controlled by thermostats, close to the point of utilization. In the opinion of the author, a 1½-gal. heater with a 500-watt element should be used for the kitchen, a setting of approximately 190 deg. F. being recommended for the thermostat so that the water will be too hot for running use. This unit may be brought up to temperature from a cold condition in approximately an hour. The cost does not exceed $30, and installation charges are low. This offers a low demand but consumes energy for several hours each day. For bath rooms 11-gal. heaters with a 1,000-watt element are suggested. Four hours are required for heating to capacity.—*Electrical Review (England)*, Aug. 26, 1927.

Electrophysics, Electrochemistry and Batteries

Electrolytic Chromium Plating.—M. HOSENFELD.—Chromium plating has gained considerable popularity during the last few years on account of the superior non-corrosive properties of this metal. Best results can be obtained from a bath containing 25 to 60 per cent chromic acid and a small amount of chromium oxide. The tank container must be of earthenware, or aluminum. The current density varies, according to the cathode material and the shape of the plated objects, between 200 amp. and 10,000 amp. per square yard of surface. Lead plates, which soon become covered with lead chromate, serve as suitable anodes. The process liberates chromic acid fumes, which destroy nasal tissues. This makes it necessary to provide an exhaust piping directly above the bath. The chromium deposit may be increased up to 2/10 mm. thickness and takes a high gloss polish. All metals, with the exception of silver and lead, can be plated. If the base metal has a heat-expansion coefficient greatly differing from that of chromium, an intermediate coating of some other metal is necessary. Various examples of accelerated corrosion tests on different objects are described, which are held to show the great superiority of chromium plating over other platings.—*Siemens Zeitschrift*, June, 1927.

A Study of the Influence of Variables on the Structure of Electrodeposited Copper.—A. KENNETH GRAHAM.—A study of the variables in the electrodeposition of copper—namely, the influence of the base metal, metal concentration of electrolyte, acid concentration of electrolyte, agitation, current density, temperature, addition agents and the cathode potentials in conjunction with each of the above variables—was made under uniform conditions, using an acid copper-sulphate electrolyte. Their effect upon the structure of the electrodeposited metal was observed, and the relation of cathode polarization to the structure of the deposit was noted. Additional confirmation was obtained of the evidence that the base metal influences the structure of electrodeposited copper. A simple device for maintaining a constant solution level and a new design of calomel electrode for preventing diffusion of potassium chloride into an electrolyte were employed.—*Paper presented before American Electrochemical Society*, September, 1927.

Miscellaneous

Studies of Internal Fractures in Bars.—ERNEST F. DAVIS and ROBERT J. PETERS.—The occasional failure of bar stock and forgings, purchased according to quality specifications and seemingly sound, which have failed during machining operations through no apparent cause led to the investigations reported in this article. The appearance of the fracture in some cases indicated an internal failure, but sometimes there was no indication. Chemical analyses of drillings obtained in the usual manner gave no clue to the fundamental cause of the breakage, and microstudies in the region of the failure do not reveal the true reason for the extreme weakness in what was assumed to be first-class material. Sulphur prints were made with bromide paper on transverse and longitudinal sections. The transverse section was in the exact location of one of the major fissures, and an intense concentration of sulphur was apparent wherever one of the larger or minor cracks appeared. The intensity of the coloration indicated that between 0.5 and 1 per cent sulphur existed in these areas. It is a well-established fact that steel containing 2 per cent or over of sulphur cannot be safely rolled or forged owing to danger of rupture on account of the weak bristle sulphur eutectoid present. It is suggested that the segregation of sulphur in rolled or forged steel constitutes a weakening factor for this class of material. The authors conclude that the existence of this condition may be found in the high price of alloy steels in just as aggravated a form as in other steels. Analyses of steel which indicate 0.043 per cent of sulphur according to steel drilling and the usual routine methods of obtaining samples can give no information of high sulphur spots. It is stated that these internal ruptures may account for many unexpected breakages of parts not severely stressed and may be the starting of many so-called fatigue failures. Insufficient cropping of ingots and billets is possibly the major cause of this defect, as it seldom exists in more than a few bars in any heat.—*Iron Age*, Aug. 18, 1927.

Determination of Sulphur Trioxide in the Presence of Sulphur Dioxide, Together with Some Analyses of Commercial Liquid Sulphur Dioxide.—J. R. ECKMAN.—A method for determining the presence of sulphur trioxide in an atmosphere of sulphur dioxide has been developed for use through a study of the heat of formation of sulphur dioxide. Application is foreseen in control work in the manufacture of the dioxide, sulphites, sulphuric acid and in the analysis of oxygen-free products of the combustion of fuels. None of the methods given in existing literature appears to be suitable for the purpose. The methods devised and described in this pamphlet for the complete removal of sulphur trioxide by precipitation as barium sulphate in a slightly acid solution of barium sulphite and the filtration and washing of the precipitate with oxygen-free distilled water in an atmosphere of oxygen-free nitrogen have been successful.—*Scientific Papers of the Bureau of Standards*, No. 554.

London's Power Supply.—The generation and transmission of electrical energy at 22,000 volts within the area of the territory served by the London Power Company is being carried on with a view to meeting the requirements of the constituent companies. Extensions to existing generation stations are planned to the amount of 220,000 kw. and are to be completed previous to the winter of 1929-1930. A 22,000-volt transmission system is to interconnect four of the main stations, which will supply ten smaller ones at 22,000 volts. Authorization has recently been made for the construction of a generating station at Battersea, to have an ultimate capacity of 360,000 kw.—*Electrical Review (England)*, Aug. 19, 1927.

News of the Industry

State Utility Commissioners Confer

National Association, Assembled at Dallas, Hears Well-Considered Utterances on Valuation, Public Ownership and Regulation—A Dissenting Opinion

THE thirty-ninth annual convention of the National Association of Railroad and Utilities Commissioners was held at Dallas, Tex., on Oct. 18 to 21. Representatives from 38 states were in attendance, and while a large part of the program was given over to topics involving co-operation between federal and state commissions and to matters of interest to shippers and the steam railroads, electric public utility questions were not ignored.

President John F. Shaughnessy of Nevada in his address, while deprecating the fact that state regulatory initiative in the railroad field has been destroyed, showed why the states should keep control over the other utilities for all practical purposes. He said the states remain in full regulatory control of the public utilities under the jurisdiction of their various commissions, although at the outset it is recognized that there is a possibility, based on later-day decisions of the United States Supreme Court, of the federal government invading this field of activity—and this despite the fact that the railroad services, electrical services, gas services, truck and bus services and other utility services are essentially local in their characteristics. If regulation is to be the effective agency for which it is designed, it must for the future be kept close to the people. More than 95 per cent of the electrical and gas business is intrastate in character, whereas less than 5 per cent may be classified as interstate commerce.

An admirable address on valuation, although somewhat controversial in character, was delivered by William A. Prendergast, chairman of the Public Service Commission of New York. Mr. Prendergast said that the National Association of Railroad and Utilities Commissioners should assume leadership in establishing some definite basis of valuation; otherwise the question might become a political issue. He continued:

"It would prove a great public boon if there were a general agreement among utility commissioners in respect to the treatment of valuation. There is no disagreement, or should be none, that it is the present fair value of the properties that is to be determined. How can present value be determined except by present prices, subject, of course, to the depreciation in the property, this to be fixed by competent examination? It is inevitable that present prices, or reproductive prices if you will call them so, must be the basis of present value. The world of the period from 1800 to 1918 is gone forever; its examples, its traditions, its precedents are obliterated. A new economic age has arrived. This is the age in which we are living. It has different immigration laws, labor standards, wages, educational requirements and industrial ideals from any age that has preceded it. Let us consider our present problems in the light of present conditions."

The committee on public ownership and operation reiterated the sentiments expressed in former reports that public ownership and operation of public utility plants is not in the general public interest and not at all desirable. "Moreover," said the report, "we find it to be the consensus of opinion that private operation has made America pre-eminent in public utility service."

Warning Against Prejudice

While the state commissions indorsed as a unit the sentiments expressed by this committee, the delegate from the Interstate Commerce Commission—Joseph B. Eastman—filed a minority report in which he disagreed radically with the findings of the majority. He said that the question is peculiarly one in which prejudice is likely to play a part, prejudice which may be and usually is quite unconscious. "Aside from religion," said Mr. Eastman, "there is perhaps nothing that so excites prejudice as the fear of being separated from the opportunity of profit. Under public ownership and operation of railroads and other public utilities the field for profit on the part of bankers would unquestionably be curtailed very materially. The officers of the private companies fear that they would be displaced or their salaries reduced. Certain of the directors may fear the loss of the lucrative opportunities which grow out of advance knowledge of coming corporate events. Those who furnish the private companies with supplies or services, often under the generous guardianship of holding companies, fear interference with existing profitable relationships. Those who perform functions which are not strictly public but may be affected with a public interest, such as insurance, fear that more direct public interference with their affairs may be encouraged. Even we ourselves, as a part of the present system of private operation under public regulation, may possibly fear interference with our jobs. All these things, and many others which might be mentioned, are sources of prejudice, conscious or unconscious, against which those who wish to think soundly must be on their guard."

The loopholes and weaknesses of regulatory laws, as well as handicaps to commissions in the different states, were pointed out in a 1,000-page report by Adolph Kanneberg of the Wisconsin Railroad Commission. The report consists of a digest and classification of statutes relating to the regulation of electric companies and covers subjects of significance in public utility regulation.

Progress of Regulation

Progress in making more effective and improving laws regulating public utilities has not kept pace with the increasing complexity of new problems created by the great expansion of public utility properties, declared Lewis E. Gettle, chairman of the Wisconsin commission, in his report as chairman of the association's special committee on uniform regulatory laws. "Within the experience of every regulatory commissioner," said Chairman Gettle, "the utility business has grown by leaps and bounds, and it is rapidly concentrating into the holdings, not only of operating corporations, but such great operating corporations are rapidly being concentrated into the still greater so-called holding corporations. Especially in the electric field, primary transmission lines are constantly expanding in capacity for volume and distance. It is not unusual, even at this time, for three or more states to be served from the same original sources of power.

"Inasmuch as three great bodies—the American Bar Association, the national conference and this association—are diligently working in the same field, there should be a continuation of the relationship between these three bodies which this association directed a year ago, to the end that the strongest and best possible uniform act may ultimately grow out of the joint deliberations. It is probably too much to expect as a final accomplishment the adoption of a uniform law in all the states, or, perhaps, even in the majority of the states, but it will, we think, be certainly worth while ultimately to offer to the various state legislatures a compilation of proposed law, from which vital portions may be adopted, and other portions adapted to the public opinion or policy or constitution of such states."

Among the other speakers who addressed the convention on matters pertaining to the electric light and power industry were F. A. Farrar, vice-president of the Electric Bond & Share Company, whose topic was "Financial Problems of Utilities," and John S. Wise of the Pennsylvania Power & Light

Company, who explained the very comprehensive set of rules and regulations adopted by Pennsylvania for rural electrification.

HOLDING COMPANIES CRITICISED

Holding companies came in for much criticism at the convention, the discussion being especially adverse in the case of companies formed by stock manipulators. A résumé of this discussion will appear in the ELECTRICAL WORLD of next week.

The following officers were elected: President, Henry G. Wells of Massachusetts; first vice-president, Lewis E. Gettle of Wisconsin; second vice-president, Charles Webster of Iowa; secretary, James B. Walker of New York; assistant secretary, Clyde S. Bailey of Washington, D. C.; general solicitor, John E. Benton of Washington, D. C.

Eastern Inspectors Take Steps Toward Amalgamation

An important forward step in the unification of electrical inspectors' associations was taken at Springfield, Mass., at the annual convention of the Eastern Association of Electrical Inspectors, which met in that city on Oct. 12 and 13. In connection with the convention a meeting of the board of directors of the Eastern association was held at which a resolution favoring amalgamation at the earliest date possible was unanimously adopted. A delegation recently appointed by the Western Section, International Association of Electrical Inspectors, was present by invitation and discussed the question at length with the board. The fullest degree of co-operation was expressed throughout. When the resolution was announced to the members in attendance at the convention an informal expression on their part indicated that they were unanimously in favor of the proposed action. There remain, of course, many details to be worked out, but the prospect is bright for early unification.

The convention itself, with one hundred members present, was enthusiastic. It spent two days in discussion of the National Electrical Code, the discussion of each article being led either by the chairman or a member of the corresponding article committee of the electrical committee of the National Fire Protection Association. Matters relating to the early days of the code were recalled in a talk by F. E. Cabot, former chairman of the electrical committee, and the code of the future was discussed by A. R. Small, its present chairman.

A demonstration and talk on resuscitation made by A. A. Packard of the Connecticut Power Company, a well-conceived address on "The Year We Celebrate" by C. M. Goddard, former secretary of the electrical committee, and numerous papers, with animated discussion from the floor of code problems, made the convention most instructive and interesting.

Marconi for Beam Stations

Italian Inventor Explains Advantages and Drawbacks of This Short-Wave Method of Radio Communication

LONG-DISTANCE radio telephone and telegraph communication by the use of short waves and directive sending was the subject of a lecture by Senator Guglielmo Marconi to the American Institute of Electrical Engineers and the Institute of Radio Engineers in New York on Oct. 17.

Great Britain is now headquarters for world-wide communication with other divisions of the empire, and South Africa, Canada, Australia and India are now in direct communication with London, Senator Marconi said. The advantages of the short-wave beam stations, as outlined by him, are that they give more words per minute, permit superimposed telephone and telegraph communication simultaneously, use far less energy in sending, eliminate static interference and permit more communication channels to be used. Wave lengths used vary between 8 meters and 60 meters and are varied at different hours to take advantage of the best conditions.

The disadvantage of the beam station lies in the fact that "fading" occurs and "ship distances" are encountered. Successful commercial operation is had at nearly all hours when working in either direction between the poles, but the paths around the earth are seriously affected by terrestrial radiations. Senator Marconi said that knowledge of space is still lacking for the accurate development of radio communication and that in the future it will be possible to utilize electric waves far more efficiently and effectively. He predicted the use of short waves and directive sending in broadcasting because this practice would give more channels of communication and because reception would be good during daylight hours.

Dr. M. I. Pupin presided at the meeting, and a large and enthusiastic audience was present.

Southern California Edison Loses in Supreme Count

The United States Supreme Court on Oct. 17, holding that no federal question was involved, dismissed, without a written opinion, the appeal of the Southern California Edison Company against Amelia Heminghaus and others who had been victorious in the California Supreme Court in a suit to restrain the power company from storing water in the upper San Joaquin River and its tributaries for hydro-electric development. The progress of this case was referred to in the ELECTRICAL WORLD for Aug. 6 (page 275) and previous issues.

The company had a license from the Federal Power Commission for its development, most of which was on federal public lands. The plaintiffs in the injunction suit own swamp and overflow land far below the power works, and they claimed the right as riparian owners to a full flow of the stream in order to overflow their lands for the production of grass and other crops. The State Supreme Court, by a divided vote, held that storage of water is not a proper riparian use and hence granted the injunction. The company appealed on the ground that the state decision involved federal questions of the use of water, licenses by the Federal Power Commission and other points it thought subject to review by the United States Supreme Court.

Thomas A. Edison Before the Microphone

Every confidence was expressed, as the ELECTRICAL WORLD prepared to go to press, by officials of the General Electric Company that Thomas A. Edison, despite his rooted objection to addressing the public by word of mouth, would answer over the radio from his laboratory at Orange, N. J., questions that had been prepared for broadcasting by E. W. Rice, honorary chairman of the General Electric board of directors. The idea was to treat the radio listeners to a dialogue of exceptional interest, and the occasion was "electric night," observed on Oct. 21 as a tribute to Mr. Edison, that day being the forty-eighth anniversary of his invention of the incandescent lamp. The program, which was sponsored by the General Electric Company and was to be broadcast from 41 stations in the United States, included talks by Gerard Swope, president of the General Electric; John W. Lieb, vice-president of the New York Edison Company, and others, and music by Goldman's Band.

Change to Private Ownership Profits Iowa Consumers

A report just printed by Arthur H. Ford, professor of electrical engineering at the Iowa State College, covers a study made of 27 small towns and cities in that state which have sold their generating plants and distribution systems to private companies and of 35 other towns that owned distribution systems which they have sold to private companies. This study shows that as a result of these sales domestic users of 15 kw.-hr. per month have had rates reduced 24 per cent, those using 20 kw.-hr. have had a 14 per cent reduction; 30 kw.-hr. per month, 24 per cent; 40 kw.-hr. per month, 24.6 per cent; 50 kw.-hr. per month, 25.3 per cent, and 75 kw.-hr. and over, a reduction of 27 per cent.

The report shows only slightly different results where towns that have been buying wholesale and distributing the energy themselves have turned over the whole service to the private companies. For additional services, covering cooking, refrigeration and power, the municipal rates were cut in two by the change.

Many Voices Raised at Chattanooga

Hydro-Electric Development, Rural Electrification, Public Utility Legislation and Other Themes Discussed at Southern Appalachian Power Conference

LIFTING the embargo now resting on power development on the Tennessee River and its tributaries, the use of power from Muscle Shoals and methods for disposal of the Muscle Shoals controversy, the question of whether there is a "power combine" affecting the public welfare, flood control and its relation to power development, interconnection of transmission systems and decentralization of industry were the major topics discussed at the Southern Appalachian Power Conference held in Chattanooga, Tenn., on Oct. 13 to 15. Men prominent in political, professional and business life were among the speakers and represented all sides of the subjects brought forward.

Among the resolutions adopted by the conference those directly bearing on the light and power industry favored continuation of private ownership with public regulation of utilities, the continuation of farm electrification work, a disposition of Muscle Shoals power that will provide for its widest and most diversified public use, a plan of constructive co-operation between the states and the federal government on questions of hydro-electric development, further inventory of water resources by the Geological Survey, and the education of the public on all questions pertaining to water-power problems.

After an address of welcome by Mayor E. D. Bass of Chattanooga, to which Joseph Hyde Pratt, chairman of the executive committee, responded, W. H. Onken, Jr., editor of the ELECTRICAL WORLD, condemned political interference with water-power development at Muscle Shoals and at other sites. He opposed amendments to the federal water-power act which would tend to weaken the law, referring specifically to several bills scheduled for introduction in the approaching Congress. Movements now on foot to obtain special legislation for certain power sites would, he said, if approved, result in partial repeal of the act and would eventually lead to its disintegration. As regards Muscle Shoals, he believed that it should be transferred to private management under conditions which would dedicate it to public purposes.

Paul S. Clapp, managing director National Electric Light Association, emphasized the industrial and economic development witnessed in the Southeast, a movement unparalled in the whole commercial history of the country, and said that the electrical industry is vitally interested in the growth and development of the communities served. He opposed further regulation of the electric industry, declaring supervision by the state to be adequate and effective.

Josiah T. Newcomb, counsel of the Joint Committee of National Utility Associations, answering the question "Is there a power combine affecting the public welfare?" referred to the findings of the Federal Trade Commission to the contrary, pointed out that interconnection does not involve corporate control or combination, and expressed the view that the "so-called holding companies, more properly financing and managing companies, far from creating a tendency toward combination and control by a single interest in the electric light and power business, are the very agencies which have avoided any possibility of it." The manufacturing branch of the electrical industry, Mr. Newcomb said, has constantly fostered the independence of the generating and distributing companies. There is no true natural monopoly in the light and power business, even in local communities, he maintained, and the cry of a "power trust" has retarded constructive discussion of practical problems—very notably in the case of Muscle Shoals.

Mercer Reynolds, president of the Chattanooga Chamber of Commerce and a prominent manufacturer, asserted that his annual power bill was about $150,000 a year and that he would be forced to pay an additional $50,000 a year if the hydro-electric development of the upper Tennessee did not take place in the near future.

MERRILL ON STATE LAWS

In his study of state water-power laws and their importance from the standpoint of the federal water-power act, O. C. Merrill, executive secretary Federal Power Commission, dwelt on the differences in theory and practice that are manifest in the water-power legislation of the various states. He pointed to the three separate bases on which federal authority rests — ownership of public lands, jurisdiction over navigable waters and the possession of all treaty-making rights where international developments are concerned. Too much emphasis, Mr. Merrill said, has been placed on the possibility of conflict between national and state law, and there has been too little appreciation of the fact that both agencies are created to serve the public interest, not their own prerogatives, and that the public interest can be better protected by the two agencies working together than by either working alone.

Mr. Merrill urged the passage of comprehensive state water-power laws based on the policy of full public control, saying that it is much better that the authority of state and nation should overlap than that there should be any zone within which neither has authority. "One principle that should be established and maintained," he said, "is that values inherent in a public resource developed and used in the performance of an essential public service by an agency created by law for that purpose shall not be capitalized for purposes of sale, of establishment of rates, or of issuance of securities in an amount in excess of actual reasonable cost." He referred to wasteful use of the resource itself by uneconomic and non-continuous development and to wastes in construction costs which could be prevented by state inspection of construction and current audit of construction accounts.

In conclusion, the speaker, while expressing his belief in private development, said: "If it is found impossible because of interpretations of law or otherwise to place public-service undertakings operated by private capital on the basis of a reasonable return on a reasonable investment, it may then become necessary to consider whether, notwithstanding certain difficulties more or less inherent in public undertakings, the necessary service may not, nevertheless, be secured at less expense through public agencies."

"Does the federal power act invade the rights of the states?" was discussed by Richard Gleaves, a member of the Tennessee State Legislature, who answered "no," because "no license can be granted to a licensee who has not complied with the laws of the state."

Flood control was discussed by John M. Parker, flood relief director of the Mississippi Valley and former Governor of Louisiana; Richard Woods Edmonds, *Manufacturers' Record*, and Major D. H. Connolly, United States Army engineer. Water-power development in relation to navigation was discussed by Major G. H. Edgerton, chief engineer Federal Power Commission, who gave a comprehensive survey of the developments in the South. He pointed out the community of interest existing between power and navigation and sketched the history of federal legislation affecting both. He was followed by Major L. M. Watkins, district engineer at Chattanooga, who showed how easily navigation, power and flood control issues may conflict.

MUSCLE SHOALS AND FERTILIZER

H. E. Howe, editor of *Industrial and Chemical Engineering*, speaking on "Chemistry in Industry," opposed the use of Muscle Shoals for the manufacture of fertilizers on the ground of new chemical development. He said that while the nitrate plants erected at Muscle Shoals in 1917 were fully justified, the research worker in chemical laboratories has brought about an entirely new situation throughout the world. He deplored efforts to mislead the farmer about illusory savings.

Separation of power production at Muscle Shoals from nitrogen production and the lease of the power free from any limitations on the use to which it is to be put were advocated by Senator Frederic M. Sackett of Kentucky, Representative William C. Wright of Georgia, John H. Small, former chairman of the House rivers and harbors committee; L. O. Crosby and A. F. Lever.

Rural electrification was ably discussed by Eugene Talmadge, Commissioner of Agriculture of Georgia, and E. A. Stewart, professor of agricultural

engineering, University of Minnesota.

L. O. Crosby of Mississippi was elected vice-president of the conference for the year beginning next January and Wilbur Nelson of Virginia secretary. An executive committee, with Joseph Hyde Pratt as chairman, will select a president. Atlanta was recommended as the next meeting place.

Purchases and Mergers

Fitkin Sells Inland Power & Light to Insulls and Retires from Utility Business—Byllesby Takes Over Wisconsin Valley Electric

SALE of the Inland Power & Light Corporation for $30,000,000, including funded debt, to Samuel Insull & Son, Inc., was announced on Oct. 17 by A. E. Fitkin, who in March last disposed of his controlling interest in the National Public Service Corporation to Day & Zimmermann, and a little later of his interest in the Western United Corporation to E. H. Rollins & Son. With the sale of the Inland Power & Light Corporation Mr. Fitkin announces his retirement from the public utility field. The Inland Power & Light controls the Kansas Power Company, Missouri Public Service Company, Michigan Public Service Company, Arkansas-Missouri Power Company and Dalhart (Tex.) Public Service Company. They furnish electricity to 58,000 customers, have a capacity of 33,068 kw. and own 2,252 miles of transmission lines.

John J. O'Brien, president of H. M. Byllesby & Company, has announced the acquisition for the Standard Gas & Electric Company of the Wisconsin Valley Electric Company and subsidiaries. The acquired company has headquarters at Wausau, Wis., and has hydro and steam electric stations with total capacities of 23,946 hp. Its properties lie between those of the Northern States Power Company and the Wisconsin Public Service Corporation and are well located for interconnection with these Standard Gas properties. The acquired company provides electricity, gas and transit for 25 communities and operates 268 miles of transmission lines.

The Southern California Edison Company has filed an application with the California Railroad Commission asking permission to purchase the controlling interest in the Ontario Power Company by the acquisition of 5,000 shares of common stock at $125 per share. This stock is now owned by the San Antonio Water Company. The Ontario Power Company serves 6,500 consumers in a territory which includes the cities of Ontario and Upland, territory entirely surrounded by Edison-served districts. The Ontario company operates three small hydro-electric plants on San Antonio Creek. These supply 40 per cent of the energy distributed, the rest being purchased from the Southern California Edison.

The California Railroad Commission has given the Pacific Gas & Electric Company permission to absorb the Vacaville Water & Power Company, and the outstanding stock of the Vacaville company, amounting to about $125,000, will be exchanged for stock of the Pacific Gas & Electric.

Several power companies are said still to be desirous to acquire the municipal electric plant at Kinston, N. C., for which the city refused two offers of approximately $650,000 earlier in the year. Supporters of the municipal plant say that, if sold, it should bring $800,000 or $1,000,000. Williamston (N. C.) voters will ballot in November on the sale of their plant to the Virginia Electric & Power Company.

Purchase of the electric light and power plants at Leander, Round Rock, Pflugerville and Hutto, all in central Texas, by the Texas Power & Light Company of Dallas is announced. The three plants named last had belonged to the Lone Star State Power Company.

The Windsor (Mo.) Light & Power Company, which distributes energy purchased from the Missouri Public Service Company, has contracted to sell its business to that company if the latter can obtain a franchise from the city, where there is agitation for a municipal plant.

Authority has been asked by the Southern Indiana Light & Power Company from the Indiana Public Service Commission to purchase the Trafalgar Light & Power Company and other property owned by the H. F. Clevenger Electric Company, serving small towns in the vicinity of Columbus. The total value of the properties sought is about $115,000, according to the petition.

Citizens of Wood Lake, Minn., have voted to sell the municipal electric distributing system to the Northern States Power Company.

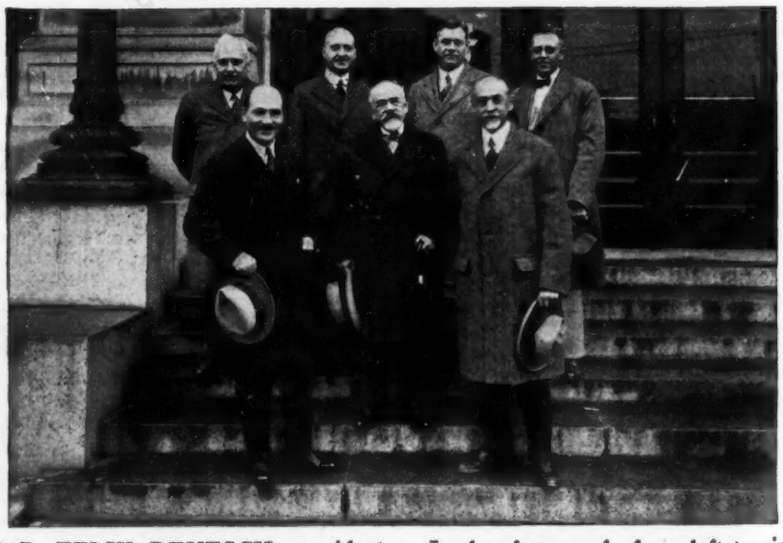
Public Service Dedicates New Switching Station

Officers and directors of the Public Service Electric & Gas Company entertained more than three hundred guests at a luncheon and inspection of the company's new switching station at Trenton, N. J., on Tuesday of this week.

President Thomas N. McCarter presided at the luncheon and said that the new station would not only better service in the Trenton area but was a step in progress since it was an interconnection point with other utilities. Energy for the station is supplied largely by the Philadelphia Electric Company and this interconnection permits economies in service. President Walter H. Johnson of the Philadelphia Electric Company spoke briefly and pointed out the advantages to the public and to the utilities of the interconnections in New Jersey and Pennsylvania. The Mayor of Trenton also spoke and complimented Mr. McCarter on the good service rendered Trenton and the co-operative and friendly spirit shown by the Public Service Company.

On Wednesday the stockholders, power customers and members of civic organizations inspected the station, and the public, college students and Public Service employees were invited to do so on Thursday. The station covers about 13 acres and cost about $1,500,000. It is designed for 50,000 kw. and for 132-kv. incoming transmission lines. It steps down the voltage to 26,400 for serving feeders to subordinate plants.

Dr. Felix Deutsch Visits General Electric Company



DR. FELIX DEUTSCH, president of the Allgemeine Elektrizitäts-Gesellschaft, was the guest of the International General Electric Company at Schenectady this week. He made a trip of inspection through the General Electric laboratory and plant and was entertained on Tuesday at a luncheon attended by President Gerard Swope of the General Electric Company and a large number of other officers of the General Electric companies.

In the photograph, from left to right, are: (Back row) James A. Smith, general superintendent of the Schenectady plant; Dr. E. Adler, manager foreign department A.E.G.; W. V. B. Van Dyck, manager Schenectady office, I.G.E., and W. J. Becker, commercial engineer I.G.E.; (front row) Dr. E. Mayer, representative of the A.E.G. at the General Electric Company; Dr. Deutsch, and M. A. Oudin, vice-president I.G.E.

Illuminating Engineers to Widen Their Field

Commercial Application of Engineering Principles Declared Vital to Development—"Lighting Service Manual"—Aëronautical and Railroad Lighting

FEATURES of the last two days' sessions of the Illuminating Engineering Society in Chicago last week were the presentation of the three concluding sections of the "Lighting Service Manual" prepared by the joint committee of the I.E.S. and the National Electric Light Association, the joint session with the National Committee for the Prevention of Blindness and a discussion of airport, airway and aëronautical lighting. The first two days' sessions were reported last week (page 803).

In an address on "Lighting Practice —Past, Present and Future," James E. Davidson, chairman of the N.E.L.A. Commercial Section, bespoke the cooperation and assistance of the illuminating engineer in the commercial movement looking to fuller utilization of lighting equipment in the home, office and factory. In commercial development, Mr. Davidson said, the electrical industry is about eight laps behind every other, and unless the engineer gains the proper commercial conception and significance of his achievements his efforts will go for naught.

Outlining the concluding section of the "Lighting Service Manual," W. H. Rademacher described the methods of using sales aids, including newspaper advertising, personal letters, "direct-by-mail" literature, lectures, displays and so forth. The lighting campaign section of the manual was discussed by H. W. Derry, who pointed out the steps necessary to conduct a well-organized lighting campaign in the major fields of application, together with the advantages and drawbacks of certain sales policies and lines of attack. Methods of keeping records and reports of a lighting service department were outlined by J. C. Fisher, who presented charts and cuts of standard reports and forms used in keeping up such a system.

At the joint session with the National Committee for the Prevention of Blindness Mrs. Winifred Hathaway, associate director, emphasized the need for better lighting in schools and described some of the work which is being done with school authorities along these lines. A most interesting address, "How We Learn to See and How We Learn Some Other Things," was made by W. T. Bovie, assistant professor of biophysics at Harvard University, in which he described the evolution of sight and the reaction of protoplasmic forms to light. The relation of the intensity of light and speed of vision, with special reference to industrial situations, was the subject of a paper by C. E. Ferree and G. Rand, and the four fundamental factors in vision—visual angle, contrast, brightness and time—were described by P. W. Cobb and F. K. Moss.

At a laboratory session on Thursday morning the following papers on photometric measurements, standardization and methods were presented: "Standardization of Methods of Heterochromatic Photometry," by A. H. Taylor; "Photometry and Watt Measurements of Incandescent Lamps on Ordinary Alternating-Current Circuits," by C. H. Sharp and E. D. Doyle; "A Photoelectric Cell Photometer," by Charles Deshler and Henry Schroeder; "Results of Practical Experiences with Photoelectric Photometry," by W. F. Little and C. E. Horn, and "Further Developments in Photoelectric Photometers," by C. H. Sharp and H. A. Smith.

In an address, "Lighting of Airports and Airways," W. P. MacCracken, First Assistant Secretary of Commerce, said that "during the current year the department will provide lighting for 3,391 additional miles of airways besides the 4,121 miles now lighted, and out of 10,000 miles of airways, 75 per cent will be equipped for night operations." The present status of aëronautical lighting was presented in a paper by Preston R. Bassett, R. W. Cost, E. A. Leinroth and H. C. Ritchie.

In a paper by H. E. Mahan and R. J. Swackhamer the problems confronting the engineer in the design of railroad-yard lighting were outlined, and another paper on daylighting in multi-story industrial buildings, by Andrew Vogel, Frank Benford, W. C. Randall and A. J. Martin, concluded the business and technical sessions.

There were 452 members and guests at the annual banquet, for which O. R. Hogue, chairman of the convention executive committee, had arranged many unusual lighting effects. A three-act playlet was given by the Commonwealth Edison Company Dramatic Club.

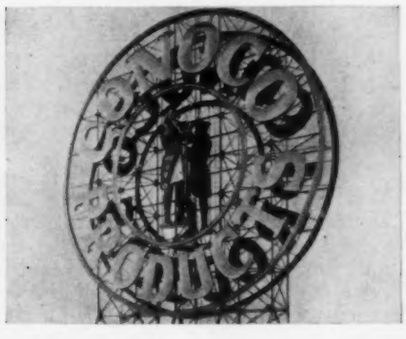
Officers of the Illuminating Engineering Society for the ensuing year were elected as follows: President, Norman Macbeth; junior past-presidents, M. Luckiesh and H. H. Higbie; vice-presidents, Julius Daniels, M. C. Huse, James Ketch, Fred A. Rogers; general secretary, L. H. Graves; treasurer, L. B. Marks; assistant secretary, Frank G. Horton. Membership in the society, now 1,638, is the largest in its history.

Central Station Offers to Save Seattle Money

The Puget Sound Power & Light Company of Seattle has made a formal offer to the City Council to furnish electrical energy for street lighting at a cost of $100,000 less than the cost estimated in the budget for 1928. Street lighting is at present furnished by the city light department, and the estimate for next year is $388,000, paid for out of the general fund of the city. The offer, made by President A. W. Leonard, said his company would furnish the estimated 10,000,000 kw.-hr. at 2 cents per kilowatt-hour to all metal poles where underground conduit wires are used and at 3 cents to all poles served by overhead wires. The present and estimated cost of the service as furnished by the city light department is 3.88 cents.

The power company's offer, Mr. Leonard notes, includes also the cost of maintenance and operation of the street-lighting system. None the less, Oliver Erickson, chairman of the public utilities committee of the Council, said that similar offers had been made before, but that on closer scrutiny it was discovered that there were costs of operation and maintenance that raised the eventual cost to more than that charged by the city light department. Superintendent J. D. Ross said that his department was furnishing energy for street lighting at 1 cent a kilowatt-hour and that the remaining 2.88 cents represented the cost of operation and maintenance.

Mammoth Sign for Denver's Business District



DENVER'S largest electrical sign and one of the largest signs in the country has recently been completed by the sign department of the Public Service Company of Colorado for the Continental Oil Company. The sign, which has a double face, is legible at 6,000 ft. Ten-watt sign lamps are used in the letters on 6-in. centers, there being 5,488 of these. The structural steel supporting the sign weighs 36,000 lb. The outside diameter of the outside circular border measures 62 in. The Continental soldier is 26 ft. high and was made in two sections. The top of the sign is 82 ft. above the roof or the equivalent in height of an eight-story addition to the ten-story Continental Oil Building. This makes the sign the highest structure but one in the city.

State and Federal Rights in Water Power

Alabama Demands that War Department Pay Taxes on Muscle Shoals Power—Tennessee Commission Challenges Federal Board on Prerogative

TWO questions involving the rights of states where water-power projects and production are involved have arisen in Southeastern states. Alabama is demanding that the War Department pay taxes on electrical energy produced by the government plant at Muscle Shoals, placing the levy at 0.4 mill per kilowatt-hour. The communication in which the Alabama Tax Commission makes this demand has not been made public by the War Department. It contains no argument, but merely asserts that under Subsection 2-D of Section 2 of an act of the legislature of Alabama, approved July 22, 1927, payment in advance from the government became due at the rate stated Oct. 1. Early settlement of the account is asked, and the Tax Commission inclosed blanks for making out the returns.

The letter was referred by Assistant Secretary Hanford MacNider to the office of Major General Edgar Jadwin, chief of army engineers, for a report and recommendations as to what reply should be made. The engineers' department has not as yet submitted its answer. In view of the wide implications of the demand as regards possible demands by other states that the federal government pay taxes where it operates property on rivers or in harbors, a legal battle is predicted if Alabama persists in her demands.

Federal "Elimination" Opposed

Right of primary selection among applicants for water-power development in Tennessee, hitherto exercised, it is asserted, by the Federal Power Commission, was formally claimed last week by the Tennessee Railroad and Public Utilities Commission. Seven firms and four individuals whose applications for preliminary three-year permits are now before the Federal commission were ordered to present their petitions to the state board by Nov. 1, in order that the necessity of the projects may be determined and certificates of public necessity and convenience issued.

The order recognizes that the federal board has ultimate supervision over questions of navigation and regulation of commerce, but otherwise proclaims "full and absolute power and control over establishment, development and operation of all water power" for the state. It is conceded, however, that the federal water-power act already provides that applicants for final licenses must first comply with all state regulations. Commissioner Porter Dunlap said the commission wanted to pass on the merits of all applicants for development, rather than on the survivors of what he described informally as the federal board's "elimination contest."

Streams on which two or more applicants seek sites, though not necessarily identical sites, are the Holston and its tributaries, the South Fork of the Cumberland, the Clinch and Powell Rivers and the Nolachucky and its tributaries. Others are sought on the Tennessee, Cumberland, Hiwassee, Obey and Obed Rivers.

New York Electrical Show Features Home Service

Elaborate and artistic displays of representative rooms in well-lighted and properly equipped homes formed a prominent feature at the twentieth annual New York City Electrical Show, held in Grand Central Palace, Oct. 12 to 22. Manufacturers and distributors of electrical goods made varied and comprehensive exhibits of new and improved devices in abundant quantities. Refrigerators, washing machines and lighting fixtures predominated. Among the newer things were a coffee percolator which automatically cuts off its current supply when the liquid level becomes low, a mirror behind which is arranged a lighting fixture supplying indirect illumination for shadowless reflection, several devices by the use of which an ordinary washtub may be made to serve as a washing machine, and a kitchen aid which by rapid interchangeability of parts serves to lighten all culinary chores. More than twenty-five thousand separate electrical devices were on display.

The New York Edison Company offered a complete showing of home appliances and lighting devices, including an exhibition by the bureau of home economics in which meals were prepared in an electric kitchen and served in a well-lighted tea room; a display by the bureau of electrical therapeutics, and inspection department, educational, radio and operating home laundry exhibits. The United Electric Light & Power Company displayed a well furnished, equipped and lighted two-wall representation of home rooms. The General Electric Company effectively located its refrigerator exhibit in a futuristic setting of columnar motif. The Westinghouse and other manufacturing companies were also represented, as usual, by comprehensive exhibits. A number of electric trucks were on display, and it was claimed by the exhibitors that the newer vehicles combine the qualities of longer service life, flexibility of operation and more rapid acceleration.

An average daily attendance of twenty thousand was registered. Among distinguished visitors was Senator Marconi of Italy, who with John W. Lieb and others spoke to the public from the radio transmitting station on Monday afternoon.

Fifty Thousand Persons at Providence Electric Show

More than 50,000 persons attended an electrical show under the auspices of the Rhode Island Electrical League at Providence on Oct. 8 to Oct. 15, all branches of the industry co-operating with Secretary H. F. Dawson to demonstrate the meaning of the "red seal" plan to the public. In contrast to many electrical shows, the exhibits were equipped to enable the public to manipulate apparatus controls associated with window lighting, color applications, traffic signals and domestic appliances, and only electrical exhibits were featured. Interconnection was emphasized by finely planned power company displays showing the benefits of interchanging steam-plant and hydro-electric energy. Models of complete detached dwelling and apartment homes, coupled with unusually comprehensive wiring outlet and fitting exhibits, aroused great popular interest, and one out-of-town visitor purchased $700 in modern luminaires upon visiting a dealer's booth.

Other features which forced the management at times to close the doors until the press of attendance could be relieved included a notable engineering equipment display by Brown University, rural service apparatus and motion pictures and an exhibit of aviation field illumination. Radio broadcasting by a nationally famous group of performers attracted many spectators. The Lowell Electric Light Corporation orchestra under Manager J. A. Hunnewell also gave a concert, and many phases of public utility work were demonstrated by the Narragansett Electric Lighting Company, the Blackstone Valley Gas & Electric Company and the New England Power Association.

Opposes Delay on the Coosa River

Gadsden Chamber of Commerce Against Extension of Permit — Pre-License Costs of Three Large Projects Approved by Federal Power Commission

FOUR delegates from the Chamber of Commerce of Gadsden, Ala., with Representative Allgood of that state, appeared before the Federal Power Commission on Oct. 10 to protest against any further extension of the preliminary permit held by the People's Hydro-Electric Company. The permit, which expired Aug. 3, covers the project on Dam No. 2 on the Coosa River. Witnesses who appeared before the commission are convinced that the company will not be able to finance the project. They are anxious to have the dam built and the power developed. If the outstanding preliminary permit is not renewed, it is believed that the Alabama Power Company will undertake the development of the site. Pending the receipt of a brief for the People's Hydro-Electric Company, the commission will take no action. The Chief of Engineers also will report on this project.

The commission has agreed to accept $162,872 to cover the pre-license costs of the Columbia Railway & Navigation Company in preparing for the development of its Santa and Cooper River project in South Carolina. The commission also approved $13,355 as a fair pre-license investment on the part of the Kentucky Hydro-Electric Company

in connection with the development of Dam No. 7 on the Kentucky River. In similar manner the commission agreed to $143,732 as a fair pre-license cost covering the project of the Pacific Gas & Electric Company on the North Fork of the Mokelumne River.

The commission approved the surrender by the Houston Power Company of its license covering a proposed development on the Choctawhatchee River in Dale County, Ala. After a thoroughgoing investigation the company decided that the project would not be profitable.

Fuel Research Reviewed and Promoted

At A.S.M.E. Meeting in St. Louis the Problems of Economical Combustion Provide Topics for Papers of Interest to Power Engineers

DEFINITE impetus to fuel research, awakened interest in fuel problems and improved performance made possible by the exchange of information are three results anticipated from a well-attended and enthusiastic meeting at St. Louis last week under the auspices of the Fuels Division of the American Society of Mechanical Engineers. Many of the papers were of especial interest to engineers in electric power plants.

In a paper on combustion and heat transfer, by Prof. R. T. Haslam and H. C. Hottel, Massachusetts Institute of Technology, the present status of knowledge on heat transmission by radiation was summarized.

A study to determine the most economical steam pressure for a certain plant was presented. Over a period of ten years, with a capacity use factor of 0.56 and low coal cost, it appeared that a 600-lb. plant would use less coal than a 350-lb. plant to the extent of a million dollars but at the expense of two million dollars in additional fixed charges.

Prof. A. W. Gauger, University of North Dakota, reported on experiments in pulverizing and burning lignite, saying that when he burned this fuel at rates from 14,500 to 17,500 B.t.u. per cubic foot per hour, he secured efficiencies as good as those common with stokers for dry lignite with high ash-fusion temperature and better than with stokers for lower-grade lignites.

Stuart M. Phelps, of the Mellon Institute of Industrial Research, asserted that refractories could be used to greater economy if furnace designers and operators were better acquainted with the properties and limitations of the products now available, particularly as radical developments in refractory products were improbable.

High rates of combustion, making necessary tremendously enlarged furnaces; the introduction of water walls, more general use of economizers and air preheaters and the call for high superheat were discussed by E. R. Fish, Heine Boiler Company, as some of the things that complicated modern design.

The recent addition to the Charles R. Huntley generating station of the Buffalo General Electric Company of four 12,500-sq.ft. direct-fired powdered-coal boilers with well-type furnaces, water-cooled walls and 76 per cent economizer surface, and the subsequent results obtained, formed the basis for an especially good paper by H. M. Cushing and R. P. Moore, who gave the reasons for making a powdered-coal addition to the stoker-fired system, traced the evolution of the furnace designed and presented a summary of operating results in which over-all efficiencies ranged from 81 to 85 per cent within the operating range of 125 to 550 per cent of rating of boilers and walls. The authors' conclusions were that the installation had demonstrated that low-fusion-ash coal may be burned in comparatively small furnaces at high maintained efficiencies and that the direct-firing system permits wide flexibility of operation with low cost per ton of coal handled.

Other papers were on recent developments in low-temperature coal carbonization by H. D. Savage, vice-president Combustion Engineering Corporation; on factors governing the purchase of coal, by Morgan D. Smith, engineer General Motors Corporation; on the burning of liquid fuels, by Ernest H. Peabody, president Peabody Engineering Corporation; on the characteristics of modern stokers, by F. H. Daniels, president Riley Stoker Corporation; on the economics of air-preheating applications, by F. M. Van Deventer, of Henry L. Doherty & Company, and on automatic combustion control, by T. A. Peebles, chief engineer Hagan Corporation.

New Yorkers Pay Visit to Saluda Plant

W. S. Barstow of New York, president of the General Gas & Electric Corporation, accompanied by Vice-president Lucien H. Tyng and General Counsel P. Chauncey Anderson of the same corporation, W. S. Murray of Murray & Flood, President J. J. Hock of the Arundel Corporation of Baltimore, prominent representatives of banking houses and others, have returned from Columbia, S. C., where they inspected the site of the Lexington Water Power Company's hydro-electric development on the Saluda River, 10 miles away. More than a thousand acres has been cleared of timber growth, several hundred men are at work, with ponderous steam shovels to aid them, and substantial progress in building this great plant, already fully described in the ELECTRICAL WORLD, was evident. Three years will be required to complete it. The initial output of 200,000 hp. has already been contracted for by the Carolina Power & Light Company, the Southern Power Company and the Broad River Power Company, another subsidiary of the General Gas & Electric Corporation.

The party was welcomed to Columbia by Governor Richardson, and public interest in the visit was shown in high degree.

Investigation Welcomed

P. H. Gadsden Favors Thoroughgoing, Impartial Inquiry Into the Public Utilities—Investment Bankers' President Asks for More Data

SEVERAL speeches of wide interest to utility companies in general were made at Chicago last week when the American Gas Association met in convention.

Assuming a determined stand against government encroachments on private business and at the same time pointing out that government is now in many lines of business largely because of the requests and desires of business men themselves, Philip H. Gadsden, who is vice-president of the Joint Committee of National Utility Associations, put forth the view that impending congressional investigations of utilities are merely smoke screens to cover definitely planned efforts toward government ownership. None the less, he added: "I do not hesitate to state that, in my judgment, we should welcome a comprehensive and thoroughgoing investigation of all the phases of the public utility business, conducted by investigators qualified by training and experience to develop all the complex facts, without partisan or sectional prejudice and free from political bias. Such an investigation would be helpful to the whole industry, but especially to those well-known and long-established groups the soundness of whose financial methods is abundantly attested by the favored position which their securities hold in the investment market and the wisdom of whose public policies is reflected in the cordial relations which they enjoy with the communities they serve."

Asserting that the Investment Bankers' Association of America has always been in favor of state regulation of the public utility business, Henry R. Hayes, president of that association, said: "We have held, too, that the business can be best operated under private ownership and enterprise. There exists no place for local regulation—so-called home rule—yet we see no need for federal regulation." Mr. Hayes went on to say that investment bankers desired the release from utility companies of adequate operating and financial data to safeguard and inform the public and the investor.

Cornelius J. Doyle, associate general counsel of the National Board of Fire Underwriters, asserted that the true functions of government are far removed from the many and diverse undertakings which, if not checked, will lead the American government into the pitfalls of collectivism. Bernard J. Mullaney, People's Gas Light & Coke Company, Chicago, deplored the preponderance of space permitted by editors to those who attack utilities with destructive intent as compared with the space given to the industries themselves. This condition, Mr. Mullaney said, is largely caused by newspaper interest in personalities rather than issues or ideas. Even at that, however, public utilities are getting fairer treatment than ten years ago.

Briefer News

JOPLIN, MO., TO HAVE NEW SUBSTATION.—The expansion program being carried out by the Empire District Electric Company in Missouri includes among its items a new substation in North Joplin, Mo., at Tenth and Wall Streets, to cost approximately $250,000 and serve Joplin and nearby places.

DAMMING THE NIOBRARA.—A 50-ft. dam, a mile long, across the Niobrara River, 15 miles southwest of Spencer, Neb., is projected by the newly incorporated Niobrara River Power Company. The proposed dam will be about 7 miles southeast of the Northern Nebraska Power Company's dam on the Niobrara and is sponsored by the same group.

FORT WORTH TO HAVE ELEVEN "WHITE WAYS."—Construction of seven "white way" systems in Fort Worth, Tex., costing a total of $100,411 and extending along nearly 8 miles of streets, will be started within the next few weeks. In addition, contracts are to be awarded this month for four other "white ways," covering approximately 5 miles of streets.

MEMPHIS COMPANY'S PROGRAM.—The Memphis Power & Light Company will exceed the construction budget of about $2,000,000 with which it started the year. A new substation at Lane Avenue and Decatur Street will cost approximately $300,000. Transmission lines are to be extended, and the distribution system of Germantown, formerly municipally owned, will be rebuilt and connected with the company's lines.

RICHMOND (IND.) MUNICIPAL PLANT TO BE DOUBLED.—A new 10,000-kw. turbo-generator that will double the producing capacity of the municipal light plant at Richmond, Ind., will arrive for installation on Nov. 1, and all alterations necessary to house the new unit have been completed. It was necessary to remove an old engine, raise the roof of the plant and construct a foundation for the new unit, according to Dan C. Hess, superintendent.

INTERSTATE POWER COMPANY'S MAQUOKETA PLANT STARTS.—Operation of the new 1,800-hp. hydro-electric power plant of the Interstate Power Company on the Maquoketa River at Delhi, Iowa, has started and the plant is now in full operation. Construction began eighteen months ago. With a working head of 35 ft. the dam is the highest in the state. A highway bridge is built as an integral part of the dam. The plant is connected to a 33,000-volt transmission line running from Oelwein to Dubuque, where it taps into the general transmission system of the company. The new dam will form a lake 10 miles long, covering 750 acres.

TEXAS-LOUISIANA COMPANY TO EXPAND ITS OPERATIONS ON OKLAHOMA BORDER.—Plans are being drawn by the Texas-Louisiana Power Company for a 2,700-kw. plant at Nocona, Tex., to cost approximately $325,000. From it there will be constructed new transmission lines into northern Texas and Oklahoma towns within a radius of 75 miles.

CONTRACT FOR BRIDGE RIVER TUNNEL IN BRITISH COLUMBIA LET.—Contract for the boring of the Bridge River tunnel, a part of the British Columbia Electric Railway Company's new power project, has been awarded at a cost of $1,249,530. Work will be commenced immediately at the Seton Lake end of the 2½-mile 13-ft. bore and will be started at the Bridge River end on May 15, 1928. The time limit allows the contractors till August, 1930, for the completion of the bore. Plans for other parts of the Bridge River development call for completion by the autumn of 1930. The entire project, it is estimated, will involve an expenditure of $13,000,000. Energy will be transmitted a distance of 120 miles south of the city over a new 165-kv. line with concrete and steel towers.

SEATTLE MAY STOP MERCHANDISING.—Possibility of the Seattle light department eliminating retail merchandising as one of its activities is being discussed by the City Council, merchants having entered strong protests against the city's operation of a retail store. The city comptroller says that by its operations in this line the light department lost $102,000 during 1926. Some councilmen believe that if the city department would limit its activities along retail lines to the sale and installation of ranges there would be no complaint. Mayor Bertha K. Landes also believes that the department should not continue to sell electric washing machines, flatirons, ornate light fixtures and other miscellaneous equipment.

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see the ELECTRICAL WORLD for July 2, page 50.]

National Electrical Manufacturers' Association—Apparatus Division, Briarcliff, N. Y., Oct. 24-27; Radio Division, Edgewater Beach Hotel, Chicago, Nov. 28-Dec. 1. S. N. Clarkson, 420 Lexington Ave., New York.

Public Utilities Association of West Virginia—Parkersburg, W. Va., Oct. 26-27. A. B. McCrum, 514 Charleston National Bank Bldg., Charleston.

New England Central Station Association of Power Engineers—Chamber of Commerce, Boston, Nov. 2. T. D. Bond, C. H. Tenney & Co., Boston.

National Electrical Credit Association—Philadelphia Division, Nov. 11; New York Division, Dec. 13. F. P. Vose, 1008 Marquette Bldg., Chicago.

Electrical Supply Jobbers' Association—Book-Cadillac Hotel, Detroit, Nov. 14-18. F. Overbagh, 411 S. Clinton St., Chicago.

American Physical Society—Chicago, Nov. 25-26; Nashville, Dec. 28-30. H. W. Webb, Columbia University, New York.

National Association of Utility Secretaries—Oklahoma City, Dec. 5-7. E. F. McKay, 307 Local Bldg., Oklahoma City.

FIVE NEBRASKA COMPANIES INTERCONNECTED.—Five of the largest power companies in Nebraska are now interconnected. These are the Central Power of Grand Island, the Southern Nebraska of Superior, the Western Public Service of Scottsbluff, the Iowa-Nebraska of Lincoln and the Nebraska Power Company of Omaha. The final link was completed when the first two named, in both of which the Insulls have large holdings, were joined very recently at Clay Center by a transmission line from Grand Island.

EASTERN SHORE PUBLIC SERVICE COMPANY'S VIENNA (MD.) PLANT.—Following a tour of inspection in which 125 employees from Maryland and Delaware were included it is announced that the power plant being built at Vienna, Md., for the Eastern Shore Gas & Electric Company, the name of which has just been changed, with the approval of the stockholders, to the Eastern Shore Public Service Company, will be completed by next April. It will be rated at 12,000 kw. and cost $1,500,000. A rate cut of 15 per cent will be put into effect by the company on Dec. 1 if the Maryland commission approves.

NEW UNIT FOR COLUMBUS (GA.) COMPANY.— Work will begin soon on a new 15,000-kw. unit for the Columbus Electric & Power Company's hydro-electric plant at Bartlett's Ferry, Ga. The plans call for enlargement of the present power house, now 90 ft. by 76 ft., to at least double its present size to take care of the unit planned and later on of a third unit of the same size. The cost will be approximately $850,000, and it is expected that the new generator will be in operation within twelve months. The Columbus Electric & Power Company and South Georgia Power Company together serve 52 cities and towns in south Georgia.

SAGUENAY-QUEBEC 187-KV. LINE IN COMMISSION.—Official inauguration of the Saguenay-Quebec double-circuit 187-kv. transmission line took place in the city of Quebec on Oct. 12, presided over by Premier Taschereau, who turned a switch throwing on the energy generated at Isle Maligne, 136 miles away. The words "Saguenay-Quebec" flashed by electric light bulbs suspended from the power lines told the story of the completion of the epochal enterprise. Premier Taschereau remarked that the day was one of the greatest in the history of Quebec. He could scarcely believe that the people would ever see a greater day in the history of industrial possibilities in that region. The power developed at present will be 100,000 hp., with provision for an increase to more than 200,000 hp. This additional supply

will be used in part by the Quebec Power Company for its own purposes, but a large part of it will be taken by the new Anglo-Canadian Pulp Mills at Quebec. A description of the line was printed in the ELECTRICAL WORLD for May 21 (page 1082).

NEW TRANSFORMERS FOR NIAGARA, LOCKPORT & ONTARIO. — Four transformers rated at 12,000 kw. each have been unloaded at the Niagara, Lockport & Ontario Power Company's station in Lockport, N. Y. The building which is to house them is about half completed, and it is expected that the station will be ready for operation about Jan. 1. The transformers, each of which weighs about 90 tons, have been set up and are ready for installation. The steel switching structure outside the new addition is well under way.

BUFFALO GENERAL ELECTRIC'S COMING GENERATOR.—The 75,000-kw. single-cylinder turbo-generator—probably the largest of its type yet made—which, as already reported, has been ordered for installation next year in the Charles R. Huntley steam station of the Buffalo General Electric Company will, like its five smaller predecessors in this station, be of General Electric manufacture. It will be rated at 83,333 kva., 90 per cent power factor, 1,500 r.p.m., 25 cycles. The turbine will be operated under standard station steam conditions of 250 lb. pressure, 250 deg. superheat and 1-in. absolute back pressure. The new machine will be used to deliver base power, while the smaller ones will act as standby equipment for peak conditions. The four new powdered-coal boilers will be adopted to local conditions and similar in type to those installed last year. The generating unit will add 50 per cent to the capacity of the station, making the total in excess of 225,000 kw. The turbine room will be extended 75 ft. and the boiler room 105 ft. to accommodate it. Combined, the turbo-generator will weigh 759 tons.

ALABAMA POWER COMPANY TO DEDICATE "JORDAN DAM" AT LOCK 18.—After Nov. 21 the hydro-electric development of the Alabama Power Company now under construction at Lock 18 on the Coosa River near Wetumpka will bear the name of Jordan Dam. On that date it will be dedicated with appropriate ceremonies. This step is being taken in honor of Col. R. A. Mitchell, senior vice-president of the company, and his brother, Sidney Z. Mitchell, director. Colonel Mitchell and his brother were born in Dadeville, Tallapoosa County, and both in early life became interested in the development of hydro-electric power, particularly on the Coosa and Tallapoosa Rivers. Colonel Mitchell has been actively connected with the Alabama Power Company and underlying companies in an executive capacity since their organization. His brother is president of the Electric Bond & Share Company, New York. The company has long desired to honor them in this way. It having already a Mitchell Dam, named in honor of James Mitchell, the first active president of the company, the brothers were asked to suggest a name and chose that of their mother, Elmira S. Jordan, who became the wife of Dr. William M. A. Mitchell.

Commission Rulings

ASSERTION OF COMPANY'S RIGHTS NOT A DEFIANCE OF COMMISSION.—A charge by the Common Council of the city of Marinette, Wis., that the local light and traction company had openly defied the commission was not sustained by the latter body. It appeared that a representative of the company had said that the company would exercise its legal right of appeal and resist in court any order of the commission requiring it to lay its tracks upon certain bridges in the city which were in contemplation or to participate in the cost thereof. The commission said that it was not advised of any violation of any order by the company or of any threat to violate and that the right of appeal from the commission's orders was reserved to the company by statute and it could not be justly censored for exercising this right or threatening so to do.

NEBRASKA COMMISSION TAKES STAND IN HARTINGTON "CONSPIRACY" CASE.—The Nebraska State Railway Commission has refused to act upon the application of the Cedar Light & Power Company of Hartington for authority to issue $25,000 worth of stock to be used to pay the Interstate Power Company for the plant taken over. It has notified all parties that it will withhold action until the time has expired when the company may appeal from the decision in the lower court in the suit brought by the Attorney-General to restrain the two power companies from conspiring to put the new city plant out of business, and if an appeal is taken, until the Supreme Court makes a final decision. Attorney-General Spillman asked for the ruling, supporting it with an affidavit in which he said that the state would oppose the creation of a corporation organized for such purposes as were charged in the suit if it persisted in its original legal attitude. (See ELECTRICAL WORLD for Aug. 6, page 279.)

OREGON COMMISSION DEFERS TO FEDERAL COURT DECISIONS IN INTERSTATE SERVICE CASES.—Although its members are not united in agreement with the principle involved, the Oregon Public Service Commission has formally announced its decision to adhere strictly to the decisions of the federal courts governing regulatory jurisdiction in connection with the resale and distribution in one state of electric light and power manufactured in another. The commission placed itself on record in an order dismissing the investigation of certain rates and charges of the Idaho Power Company which affected the service of the Vale Electric Company, an independent utility purchasing energy wholesale from the Idaho corporation and distributing it in Oregon. Citing the United States Supreme Court opinion in the case of Rhode Island vs. Attleboro Steam & Electric Company, the commission order says: "It is our opinion that under the recent decisions of the United States Supreme Court handed down subsequent to the entry of our previous order the character of the interstate service rendered to the Vale Electric Company has been held to be primarily 'national' and that the regulation thereof would be without the jurisdiction of this commission. We believe that this matter should be dismissed." In the commission's previous order a rate schedule was prescribed for "continued transmission, distribution and resale to other public utilities, on the basis of 35 per cent of the regular power rate. In the new order the commission explains that "such rate was experimental, temporary in nature, and was only placed in effect for a period of one year."

Recent Court Decisions

WISCONSIN'S RECAPTURE CLAUSE AFFECTING HYDRO SITES FINALLY CONFIRMED.—The United States Supreme Court has denied a rehearing in the case of the Fox River Paper Company and other Appleton (Wis.) corporations against the Wisconsin Railroad Commission attacking the recapture clause of the state power act. The court some time ago sustained the validity of the recapture clause under which the state or any municipality in the state may take over a power dam in 30 years by paying the public utility for the property on a basis fixed by statute. (See ELECTRICAL WORLD for June 18, page 1350.)

UNITED STATES SUPREME COURT WILL NOT HEAR APPEAL BY COMMISSION DIRECTLY FROM DISTRICT COURT.—On the ground that the case first should have been presented to the Circuit Court of Appeals, the United States Supreme Court has dismissed the appeal of the Board of Public Utility Commissioners of New Jersey from a decision of the United States District Court granting an injunction to the Middlesex Water Company against a rate schedule ordered by the commission. The commission had attempted to appeal directly from the District Court to the Supreme Court and the company entered a motion for dismissal. The Middlesex Water Company supplies water in six municipalities. In 1924 the commission ordered it to put into effect a new rate schedule which it alleged to be confiscatory. The District Court granted it an injunction.

ALASKA DISTRICT COURT'S JUDGMENT UPHOLDING MUNICIPALLY FIXED RATES UPHELD.—The United States Circuit Court of Appeals, Ninth Circuit, has sustained the District Court of Alaska in Graff vs. Town of Seward, a suit to declare confiscatory rates fixed by the town authorities as authorized by an Alaskan law. The plaintiff, owner of the light and power plant, held that since at a public hearing the only evidence on the rates prescribed was his own, which endeavored to prove them unjust, the ordinance was impeached; but the reviewing court overruled this contention, saying that the Mayor and Council were not bound to accept plaintiff's statements but could rely on their own knowledge. Unless an obvious error of law or serious mistake as to facts was established, the Court of Appeals was bound to rule in accordance with the presumption that the rates were not confiscatory. (20 Fed. (2d) 816)*.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

News About Men of the Industry

W. H. Sawyer New President of Stevens & Wood

W. H. Sawyer, who has been elected president of Stevens & Wood, Incorporated, as announced in the Oct. 15 issue of the ELECTRICAL WORLD, brings to his new position a background of valuable experience obtained in his professional career as an engineer and

W. H. SAWYER

in a business career as a manager and executive. Following graduation from the University of Nebraska he had diversified experience covering a nine-year period with the General Electric Company, after which connection he became engineer in charge of the New York office of Ford, Bacon & Davis, where he remained for nine years.

In 1914 Mr. Sawyer was elected vice-president of the E. W. Clark & Company Management Corporation, where he had further management, engineering and construction experience, which was added to by his connection with the North American Company as president of the East St. Louis & Suburban Railway Company and affiliated properties. It is this connection which Mr. Sawyer severs to join Stevens & Wood.

Mr. Sawyer has just finished his term as president of the American Electric Railway Association and has for many years been prominent in public utility association activities. In 1925 a great compliment was paid to his business and engineering ability when he was retained by the Victorian government of Australia and appointed a royal commissioner to inquire into and report upon the status and affairs of the Electricity Commission of Victoria, especially as to power generation and distribution. He obtained a leave of absence from the North American Company to undertake this work, which was accomplished with great success.

Mr. Sawyer has purchased a financial interest in Stevens & Wood, Incorporated, in connection with the corporation's expansion policy, and his attractive personality, keen mind, broad knowledge and experience, combined with a wide acquaintance in the public utility industry, will be of great value to that organization.

P. T. HANSCON has been elected a director of the Northeastern Power Corporation.

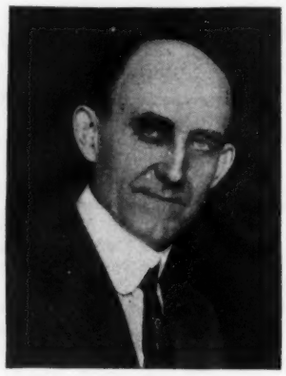
VAN HORN ELY has been elected a director of the American Gas & Electric Company to succeed Herbert H. Dean, recently resigned. Mr. Ely has been prominent in the public utility field for many years and until recently was president of the American Electric Power Company and its subsidiaries.

W. H. CORDDRY, formerly general manager of the Louisiana Public Utilities Company, one of the companies operated by Gannett, Seelye & Fleming, Inc., has been made manager of the utility operating department of the last-named firm, with headquarters in its main office at Harrisburg, Pa.

George A. Iler Leaves Youngstown Utility

George A. Iler, chief electrical engineer of the Pennsylvania-Ohio Power & Light Company, Youngstown, Ohio, has severed his connection with that utility to devote his entire time to the Iler Electric Service Company, which he organized in 1924.

As chief electrical engineer and head of the operating department of the Pennsylvania-Ohio Power & Light Company, Mr. Iler had jurisdiction over all electrical matters, including metering, construction and engineering. During his association with the electrical industry he has engaged in the construction and operation of power generating plants

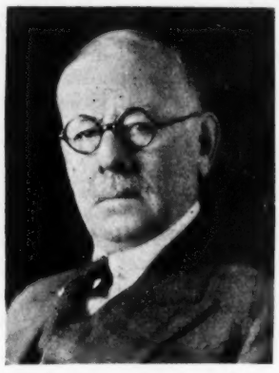


G. A. ILER

and transmission systems and in general electrical engineering in various parts of the country. This valuable practical experience was reinforced by technical training obtained at Georgia Institute of Technology. The Iler company has established new headquarters in Cleveland.

N. M. Garland to Retire from Active Service

N. M. Garland will retire from active duties on Jan. 1, 1928, after 25 years of sales activity in the New York office of the Ohio Brass Company. Mr. Garland will remain a director of the Ohio Brass Company, with headquarters in New York, acting in a consulting capacity



N. M. GARLAND

as occasion may demand and maintaining his contact and interest. Mr. Garland has the good fortune to have been connected with the electrical industry since its earliest days and has made a genuine contribution to its upbuilding. He has set a standard in salesmanship and in helpful service to the industry which has resulted in a host of friends. They regret his retirement but are glad to know that he will now be able to follow congenial pursuits rendered impossible by an active business career.

The electrical career of Mr. Garland began in 1892, when he took over the Eastern agency of the Emerson Electric Manufacturing Company. In 1897 he became general agent for the Manhattan Electric Light Company, and he continued with this utility for a time after it was merged with others to form the New York Edison Company. In 1902 he was appointed Eastern representative of the Ohio Brass Company, and he has made material contributions to the success of this company during his many years of service. Mr. Garland has always responded to calls upon him for co-operative work and has been an active participant in many developments which have bettered industry conditions. He is a member of the following clubs and societies: Edison Pioneers, A.I.E.E., N.E.L.A., New York Railroad Club, Engineers' Club, Engineers' Country Club, Railroad Club of New York, New York Electrical Society and New York Welding Society.

J. P. LEWIS, formerly transmission-line engineer of the Southeastern Engineering Company (subsidiary of the

Southeastern Power & Light Company), Birmingham, has joined the staff of the Aluminum Company of America in its St. Louis office in the capacity of sales engineer. Mr. Lewis was born March 23, 1888, at Anderson, S. C., and was graduated with the degree of B.S. from Clemson College in 1908. Between 1908 and 1916 he worked for the Chicago City Railway Company, General Electric Company, Cleveland, Southwestern & Columbus Railway Company and the Dupont Powder Company. In 1916 he joined the Alabama Power Company. He has had since then eleven years' experience in the operating, construction and transmission departments. In addition to sales work with the Aluminum Company, Mr. Lewis will act as consulting engineer on transmission-line design and construction.

A. E. Fitkin Retires from Utility Field

A. E. Fitkin, public utility operator, has announced his retirement from that field after an association with it of fifteen years. During this period of activity he acquired properties scattered through Florida, New Jersey, Arkansas, Illinois and other states. He began disposing of his holdings early this year, and during the past week the sale of the Inland Power & Light Corporation, under which were grouped the properties he had thus far retained, to the Insull interests was announced. He will conduct the business of A. E. Fitkin & Company as a general investment and Stock Exchange house. Mr. Fitkin will sail for Europe Oct. 26, where he will establish foreign contact for his investment banking business.

P. C. LYNCH of Conyers, Ga., has been transferred to Greensboro as manager of that district for the Georgia Power Company.

PROF. FOREST RAY MOULTON, director of the department of astronomy of the University of Chicago, has resigned to affiliate himself in an executive capacity with the Utilities Power & Light Corporation, Chicago.

JOSEPH F. PORTER, president of the Kansas City (Mo.) Power & Light Company, was the guest of honor at a dinner given at the Shrine Temple, Oct. 11, the occasion marking the completion of the first decade of Mr. Porter's association with the company. Approximately five hundred employees and associates of Mr. Porter were in attendance, including members of the board of directors and officials of the company. A Revere telechrome "grandfather" clock in a mahogany and walnut case, with Westminster and Canterbury chimes, was presented to him. The clock carries a gold plate bearing an engraving showing the main generating station of the company, the dates 1917 and 1927, together with a suitable inscription as to its donors.

F. W. Doolittle Elected to New Executive Position

Frederick W. Doolittle, a vice-president of the North American Company, has been elected president of the East St. Louis & Suburban Railway, East St. Louis, Ill., to succeed W. H. Sawyer, whose resignation was announced in the Oct. 15 issue of the ELECTRICAL WORLD. Since 1916 Mr. Doolittle has been retained as consulting engineer by the North American Company and its subsidiaries, handling investigations of new properties and rate and valuation cases for these companies before commissions.

A native of Hopkinton, Iowa, Mr. Doolittle received his technical training at Princeton University and at the University of Colorado. Following a short teaching engagement at the latter institution and at the University of Wisconsin, he assisted in the development

F. W. DOOLITTLE

of the statistical department of the Wisconsin Railroad Commission, subsequently doing similar work for the Illinois Public Utilities Commission. It was in 1923 that Mr. Doolittle was elected to a vice-presidency in the North American Company. Mr. Doolittle will continue to maintain headquarters in New York.

Obituary

Perley F. Walker

Perley F. Walker, dean of the School of Engineering of the University of Kansas since 1913, committed suicide Oct. 17 in his office at the university. A national figure in engineering circles, Dean Walker interested himself in a wide range of affairs outside his regular duties as head of the school. For many years he had been active in the industrial development of Kansas, and he was a valuable member of the Kansas Committee on the Relation of Electricity to Agriculture.

Dean Walker was born in Embden, Me., in 1875 and received his technical training at the University of Maine and Cornell University. Though his early work was with the Bath Iron Works as draftsman and with the Newport News Shipbuilding & Drydock Company as a calculator in the scientific department, he was essentially an educator and in the course of a distinguished academic career he was affiliated with the University of Maine and the University of Kansas, becoming dean of the School of Engineering at the latter institution thirteen years ago. Dean Walker was the author of "Management Engineering," published by the McGraw-Hill Book Company, and had contributed articles on various topics to the technical press. He served as president of the Society for the Promotion of Engineering Education in 1923-1924, was a past-president of the Kansas Engineering Society and a member representative of the American Society of Mechanical Engineers on the American Engineering Council.

WILLIAM E. BODEN, construction superintendent for the Santa Barbara district of the Southern California Edison Company, died suddenly Aug. 29. Mr. Boden had been with the Edison company continuously since 1902, beginning his career as a lineman in San Bernardino. In 1914 he was transferred to Santa Barbara, where he was at the time of his death. He was born in Illinois in 1870.

WILBUR A. BROTHWELL, for some years prominently identified with the electric light and power industry, died recently at the home of his son, Senator Charles R. Brothwell, at Chester, Conn. Early in life Mr. Brothwell was connected with the P. T. Barnum interests at Bridgeport. Later he became associated with the light and power industry. He was for a number of years a director and officer of the Essex (Conn.) Light & Power Company. In 1881 he became connected with the Russell Jennings Manufacturing Company, and he was president, general manager and a director of the company at the time of his death. He had been town treasurer of Chester for the past 39 years and had served his state both as a representative and a senator.

COLONEL H. L. REMMEL, banker and financier, died Oct. 14 at Hot Springs, Ark., after an illness of several months. Colonel Remmel was a potent factor in the building of the Remmel Dam on the Ouachita River, the first great development of hydro-electric power in Arkansas. He was formerly president of the Arkansas Bankers' Association and for ten years or more president of two of the banking institutions of Little Rock which he had organized in conjunction with other Little Rock men. A native of New York State, he removed later to Fort Wayne, Ind., and subsequently to Arkansas. Three times he was the nominee of the Republicans for Governor of the state. For about 28 years he had served as chairman of the Republican State Executive Committee and at the time of his death and for several years prior he represented Arkansas on the Republican National Committee.

Financial and Statistical News

Common Stocks Lose Ground Declines Not Large Bond Prices Firm

LOSSES have been fairly general this week in utility issues on all the markets, and trading has been more or less uninteresting. In the aggregate, the declines have not been at all substantial, however, and there are indications that the President's analysis affirming confidence in American business and industry may probably have more than a momentary effect of buoyance in the markets. In any event few authorities look for any material reaction in the power and light issues, especially since these companies would be little affected by a decline in the volume of business.

The volume of buying in the bond market continues on a large scale. It is generally felt that continued steadying of prices is to be expected more or less indefinitely. The power and light bond list shows a shortage of below-par issues, and this, of course, increases with the progress of yield adjustment to declining money rates. On the other hand, the large amount of refinancing that has taken place has reduced the number of issues selling at a premium. The double effect is a segregation of prices close to par.

New Utility Offerings Heavy

New issues of electric light and power securities during the week ended Oct. 20 were of substantial size, a sixty-six-million-dollar issue and a forty-million-dollar issue appearing among the new offerings. The former issue was in connection with the consolidation of properties in upper New York State, resulting in the formation of the New York Power & Light Corporation. First mortgage gold bonds of this new organization, 4½ per cent series, due 1967, were offered at 96 and accrued interest, to yield about 4.72 per cent.

The forty-million-dollar offering was made by the Edison Electric Illuminating Company of Boston in the form of coupon gold notes. One issue of three-year 4½ per cent notes, priced at 100 and accrued interest, yielding 4½ per cent, amounted to $30,000,000, and the other issue of one-year 4 per cent notes, priced at 99¾ and accrued interest, yielding about 4¼ per cent, amounted to $10,000,000.

The West Texas Utilities Company issued first mortgage 5 per cent gold bonds to the amount of $12,500,000 and the East Coast Utilities Company issued first mortgage collateral 5.50 per cent gold bonds to the amount of $1,000,000.

An issue of $4,000,000 W. S. Barstow & Company 6 per cent sinking-fund debentures, due Oct. 1, 1942, was offered during the week under review at 97.50 and interest, yielding about 6.25 per cent.

The Pennsylvania-Ohio Power & Light Company made an additional offering of six-dollar cumulative preferred stock, numbering 35,000 shares.

With the purpose of raising funds to acquire new properties, the Public Utilities Consolidated Corporation (Arizona) issued 7 per cent cumulative preferred shares at $100 per share.

August Central Station Revenue $135,300,000

Daily Energy Output Averages 203,000,000 Kw.-Hr.— Income Increases 8.5 per Cent, Energy 8.7 per Cent —Water Power Gains Largely

REPORTS of central-station operations received by the ELECTRICAL WORLD indicate an energy output in August of 6,283,303,000 kw.-hr., a revenue of $135,300,000 and operating expenses of $62,280,000 for the entire industry in the United States. In each of these items there is an increase from July figures. Compared with August, 1926, there has been an increase in energy production of 8.7 per cent and an increase in revenue of 8.5 per cent.

Although the gains continue, progress is somewha slower than it was in the spring. The energy output as compared with the corresponding month of the previous year was 14.4 per cent greater in May, 11.2 per cent in June and 9.8 per cent in July. Corresponding percentages for revenue are 10.8, 10.4 and 8.6 respectively. The average daily energy output in August was 203,000,000 kw.-hr.; the estimated normal for the month, on the basis of operations during the past five years, was 192,500,000 kw.-hr. Physical operations are therefore well above the pace set for them during the past few years. The average daily revenue, $4,370,000, is slightly below the estimated normal, namely, $4,520,000, but this condition has existed for many months.

The interchange of energy between companies, reflected in the figures on energy purchased for resale, seems lately to have become stabilized, for there have been no important changes in them since

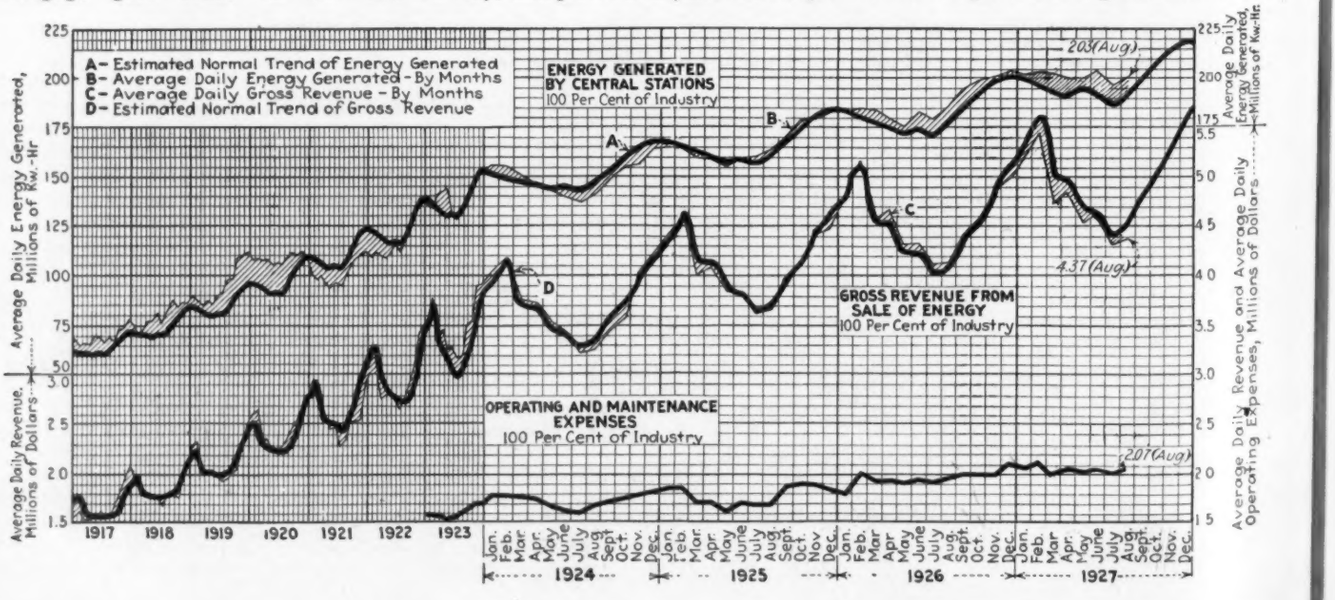

A– Estimated Normal Trend of Energy Generated
B– Average Daily Energy Generated – By Months
C– Average Daily Gross Revenue – By Months
D– Estimated Normal Trend of Gross Revenue
ENERGY GENERATED BY CENTRAL STATIONS
100 Per Cent of Industry
GROSS REVENUE FROM SALE OF ENERGY
100 Per Cent of Industry
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
203 (Aug)
4.37 (Aug)
2.07 (Aug)
Average Daily Energy Generated, Millions of Kw.-Hr.
Average Daily Revenue, Millions of Dollars
Average Daily Revenue and Average Daily Operating Expenses, Millions of Dollars
1917 1918 1919 1920 1921 1922 1923
1924 1925 1926 1927

TABLE I—GENERATION AND DISTRIBUTION OF CENTRAL-STATION ENERGY IN THE UNITED STATES
(100 Per Cent of the Industry)

Month	Kw.-Hr. Generated Monthly *			Estimated Distribution of Energy Generated										Energy Purchased by Public Utilities for Resale, Kw.-Hr.	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intracompany Business, Including Line Losses, Kw.-Hr.			
	1927 Thousands	1926 Thousands	Per Cent Inc.	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands
May..	6,218,471	5,436,704	+14.4	5,123,471	4,386,704	1,252,000	1,164,000	3,329,471	2,688,704	542,000	534,000	1,095,000	1,050,000	1,252,000	1,009,000
June..	6,127,247	5,509,356	+11.2	5,043,247	4,446,356	1,205,000	1,150,000	3,310,247	2,774,356	528,000	522,000	1,084,000	1,063,000	1,228,000	1,050,000
July...	6,110,140	5,562,172	+ 9.8	5,029,140	4,492,172	1,242,000	1,164,000	3,263,140	2,811,172	524,000	517,000	1,081,000	1,070,000	1,175,000	1,002,000
August	6,283,303	5,777,753	+ 8.7	5,173,303	4,662,753	1,265,000	1,212,000	3,381,303	2,931,753	527,000	519,000	1,110,000	1,115,000	1,275,000	1,110,000

*Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only.

May. For a time intercompany purchases were increasing at the rate of 30 to 40 per cent a year, but in August the excess over August of 1926 was only 15 per cent. This gradual stabilization in the wholesale movement of energy necessarily affects the payments received by the selling companies and may therefore have had some influence on the total revenues, which include receipts for energy sold to other utilities.

Energy produced from water power continues to increase more rapidly than the total energy output; in August it exceeded yast year's amount by 14.1 per cent and constituted over 37 per cent of the entire energy generated.

TABLE III—OPERATING RATIO OF CENTRAL-STATION COMPANIES

Month	Operating Ratio					
	Steam Plants		Hydro Plants		Combined Hydro and Steam Plants	
	1927	1926	1927	1926	1927	1926
May.	47.9	48.4	37.9	35.3	42.2	43.4
June.	48.9	49.9	35.3	32.1	42.5	45.0
July..	51.3	52.3	34.2	33.4	44.3	46.4
Aug..	52.8	53.6	34.6	36.3	44.1	45.8

The 5.7 per cent increase in energy produced from fuel was obtained with a 3.0 per cent increase in coal consumption, a very marked decrease in oil and a 15.7 per cent increase in gas consumption. Steady advances are thus evident both in the utilization of water power and in the more efficient generation of energy from fuel.

In the operating ratios of companies reporting, whether purely fuel-burning, hydro or mixed, no notable changes have occurred.

While, as is usually the case, revenue for the country as a whole shows but a slight increase in August over July, there are perceptible regional changes. New England gained about 1.5 per cent over July, the North Central States 2 per cent, the South Central States 4.5 per cent and the Mountain and Pacific group 2 per cent, whereas the Atlantic Seaboard States showed a decrease of 1.5 per cent, most of it in the northern rather than in the southern portion. The temporary downward movement is similar to that of last year, though somewhat greater.

The increase in energy output, again compared with August, 1926, was lowest in the Middle Atlantic States and next in the Mountain States, while high throughout the South and along the Pacific Coast.

ITALIAN UTILITY INCREASES CAPITAL.—Shareholders of the Società Elettrica Bresciana, Italy, have voted to increase its capital stock from 60,000,000 lire to 75,000,000 lire. The Bresciana company is a subsidiary of the Edison General Italian Electric Company of Milan, the holding and operating company in which American capital has been invested by the International Power Securities Corporation.

FIFTY THOUSAND SHARES TO BE ISSUED TO MANITOBA POWER STOCKHOLDERS.—Stockholders of the Manitoba Power Company, Ltd., will vote Nov. 10 on increasing the authorized common stock (no par value) from 100,000 shares to 200,000 shares. This company, a subsidiary of the Winnipeg Electric Company, is planning to issue 50,000 shares of this stock to shareholders at $60 per share in the ratio of one share of new stock for each two shares held.

TABLE II—CENTRAL-STATION FINANCIAL OPERATIONS FOR FOUR MONTHS IN THE UNITED STATES
(100 Per Cent of the Industry)

Month	Total Gross Revenue from Sale of Energy†			Estimated Distribution of Gross Revenue								Total Operating and Maintenance Expenses‡	
				Lighting Customers		Power Customers		Electric Railways		Other Public Utilities			
	1927 Thousands	1926 Thousands	Per Cent Inc.	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands
May....	$140,600	$126,900	+10.8	$83,100	$77,900	$42,300	$35,400	$4,800	$4,700	$10,400	$8,900	$62,280	$57,530
June....	138,600	125,500	+10.4	81,500	77,200	41,900	35,000	4,700	4,600	10,500	8,700	62,300	58,200
July.....	134,300	123,600	+ 8.6	77,700	74,700	41,900	35,500	4,500	4,500	10,200	8,900	62,400	59,100
August..	135,300	124,700	+ 8.5	79,700	77,000	41,300	35,200	4,400	4,300	9,900	8,300	64,200	60,300

†Aggregate gross revenue from actual consumers, and sales to other public utilities for resale, involving a certain amount of duplication.
‡Do not include interest, taxes, depreciation or sinking fund.

TABLE IV—OPERATIONS OF CENTRAL-STATION HYDRO AND FUEL PLANTS IN THE UNITED STATES*
(100 Per Cent of the Industry)

Month	Energy Generated						Fuel Consumption								
	Hydro-Plants			Fuel Power Plants			Coal			Oil			Gas		
	1927 Thousands of Kw.-Hr.	1926 Thousands of Kw.-Hr.	Per Cent Increase	1927 Thousands of Kw.-Hr.	1926 Thousands of Kw.-Hr.	Per Cent Increase	1927 Short Tons	1926 Short Tons	Per Cent Increase	1927 Barrels	1926 Barrels	Per Cent Increase	1927 Thousands of Cubic Feet	1926 Thousands of Cubic Feet	Per Cent Increase
May.....	2,625,427	2,266,305	+15.9	3,593,044	3,170,399	+13.3	2,918,935	2,720,082	+7.3	462,386	569,125	—18.7	4,825,262	3,712,226	+30.0
June.....	2,491,840	2,191,225	+13.7	3,635,407	3,318,131	+ 9.7	2,904,907	2,807,988	+3.4	453,025	589,567	—23.1	5,214,762	4,190,576	+24.4
July.....	2,402,377	1,971,199	+21.8	3,707,763	3,590,973	+ 3.2	2,996,670	2,993,969	+0.9	450,686	671,984	—32.8	5,598,713	5,056,094	+10.7
August...	2,353,152	2,062,629	+14.1	3,930,151	3,715,124	+ 5.7	3,152,587	3,060,647	+3.0	472,529	728,864	—35.2	6,254,403	5,403,316	+15.7

*As collected by United States Geological Survey. The data are for the electric light and power industry only.

Story of Industry's Progress Related to Bankers

J. L. Seybold of Minneapolis, Chairman of Public Service Securities Committee, Traces Development of Light and Power Industry —Responsibilities of Public Utility Leaders and Bankers

IN AN address delivered at the sixteenth annual convention of the Investment Bankers' Association of America, held recently at Seattle, J. L. Seybold, chairman of the Public Service Securities Committee, gave a brief résumé of the picture presented today, together with a historical background of the various branches of the public utility industry, including electric light and power, street railway, gas and telephone. "The relatively rapid growth of the several utility industries during the past ten or fifteen years," Mr. Seybold said, "has given the public and the investment banker, as well as the proprietors, much to think about in the way of legal and financial procedure. Principles of valuation, regulation by commissions, correct financial structure, etc., have received attention from many capable sources, with the result that most of these matters are today far along toward definite understanding."

In commenting on the electric light and power industry Mr. Seybold said:

"The electric light and power industry, like the telephone industry, has attained its present stature in less than a lifetime. Had we been present at one of the early conventions of the industry, we would have perhaps pondered over the problem of increasing the range of transmission of energy over one-half mile and weighing the serious proposal of one delegate who suggested the division of cities into square-mile units, each unit to contain a central station. If we were of courteous inclination, we would have stayed in our seats for a few moments at the end of the convention to listen to a paper on the application of electricity to motors. In apologetically asking the indulgence of the delegates, the president stated that while most of them were interested only in lighting, some time had been spent on the paper and it would do no harm to hear what the speaker might have to say. This in the early eighties.

"Today more than one-half of all the electrical energy produced in the world is generated in the United States. Transmission of energy for a distance of 300 miles is a commercial fact, and interconnected transmission lines extend from Boston to St. Louis, with radiation north through Illinois, Wisconsin and Minnesota to the Canadian border and south through the Virginias and Carolinas to the Gulf. On the Pacific Coast interconnecting systems extend from Vancouver to Mexico.

"Progress in the generation of energy has been equally marked. Stations are now under construction designed for an ultimate capacity in the near future of approximately 1,000,000 kva. While in 1885 it required 10 lb. of coal to produce one kilowatt-hour, there are instances to-day of production at the rate of 0.9 lb. per kilowatt-hour.

"Coincident with technical develop-

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday, Oct. 18	Low 1927	High 1927
ABITIBI PWR. & PAPER, 4% com.—no par	134	83	141¼
Adirondack Pwr. & Lt.—7% pf.	111	107	113½
Adirondack Pwr. & Lt.—8% pf.	112	112	116
Ala. Pwr., $7 cum. pf.—no par	112	107	112½
Allis-Chalmers Mfg., 7% pf.	m111¼	109	112½
Allis-Chalmers Mfg., 6% com.	114¼	88	118¾
Aluminum Co. of Amer., com.	95	67¼	105¼
Aluminum Co. of Amer., 6% pf.	104	101¼	104½
Amer. & Foreign Pwr., pf. 25% pd.	m110	....	....
Amer. & Foreign Pwr., 7% pf.—no par	105½	86¼	108
Amer. & Foreign Pwr., com.—no par.	27½	18¾	30¼
Amer. Bosch Magneto, com.—no par	22½	13	26¼
Amer. Brown Boveri Elec†	9½	5¼	39½
Amer. Brown Boveri Elec., pf. $7	50	40	98
Amer. Gas & Elec., 6% pf.—no par	103¾	95½	105¼
Amer. Gas & Elec., com.†—no par	113¼	68¼	117½
Amer. Lt. & Trac., 6% pf.	112	113	126
Amer. Lt. & Trac., new com.	179	164¾	186
Amer. Pwr. & Lt., 6% pf.	106½	97½	107
Amer. Pwr. & Lt., com.†—no par	69¼	54	73¾
Amer. Pub. Serv., 7% pf.	a 98½	94	104
Amer. Pub. Serv., com.†	70	....	....
Amer. Pub. Utilities, 7% pfd. pf.	a 88¼	73	88½
Amer. Pub. Utilities, 7% pr. pf.	a 93½	92	96
Amer. Pub. Utilities, com.	k 53	65	70
Amer. States Sec., A	4½	2¾	4½
Amer. States Sec., B	4½	2¾	4½
Amer. Superpwr., 6% pfd. pf.—25	29½	26¼	29½
Amer. Superpwr., 6% 1st pf.	j 98½	....	....
Amer. Superpwr., Class A†—no par	39	27½	41¼
Amer. Superpwr., Class B†—no par	40½	28¼	43
Amer. Wtr. Wks. & Elec., 7% pf.	m111	104½	111
Amer. W. W. & E., com. new—no par	62½	46	72½
Anaconda Copper cap. $3	47	41¼	49¾
Appalachian Electric Pwr., 7% pf.	107	100	105
Appalachian Elec. Pwr., com.	m 78	77	83
Arizona Pwr., 7% pf.	k 74	77	84½
Arizona Pwr., com.	m 20	....	....
Arkansas Pwr. & Lt. 7% pf.	106	....	....
Assoc. Gas & Elec., $3.50—50	51	....	....
Assoc. Gas & Elec., pf.—$6—no par	93	85	93
Assoc. G. & E., Class A, 10—no par	43½	35	43½
BABCOCK & WILCOX, 7% com.	115	113	124
Binghamton L., H. & P., $6 pf.	98	93	100
Birmingham Elec., pf.—$7—no par	108½	105	109
Blackstone Valley G. & E., 6% pf.	106	103	105
Blackstone Valley Gas & Elec., 10% com.—50	130	98	154¾
Blaw-Knox, com.†	i 96½	70	96½
Brazilian Trac., Lt. & pwr., com.†	f204	....	....
Broad River Pwr., 7% pf.	103	97	103
Brooklyn Edison, 8% com.	182	148½	184½
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	j 26½	....	....
Buffalo, Niagara & East. Pwr. com. $1—no par	j 37	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	98	96	99½
California Ry. & Pwr., 7% pf.	135	125	150
Carolina Pwr. & Lt., pf.—$7—no par	l109½	107	109½
Central & S.W. Util., $7 pf.—no par	a 98	92½	97½
Central & S.W. Util., pr.in.$7 pf.—no par	a102	98½	104½
Central Ariz. Lt. & Pwr., 8% pf.	k 97	95	98
Central Ark. Ry. & Lt., 7% pf.	106	100	104
Central Ill. Pub. Serv., $6 pf.	a 92½	88¼	95½
Central Ind. Pwr., 7% pf.	a 92½	85½	95
Central Pwr. & Lt., 7% pf.	101	100½	103
Central States Elec., 7% pf.	100	93	97
Central States Elec., com.†	30	17¼	30¾
Century Elec., 6% com.	b162	114	162
Chicago Fuse Mfg., com.—$2.50 no par	a 32½	30	35½
Cincinnati Gas & Elec., 5% com.	g 99½	....	....
Cities Service, $6 pf.—no par	l 93¾	87	94½
Cities Service, pf. B—no par	l 8¾	8	8¾
Cities Service, pf. BB—no par	l 86	80½	86
Cities Service, com.—20	l 50¾	40¼	58¼
Cities Service, Bks. Shrs.—10	l 25½	22¼	27
Clarion River Pwr., 8% pf.	95	....	....
Cleveland Elec. Illg., 6% pf.	110½	108	112
Cleveland Elec. Illg., 10% com.	322	285	330
Columbia Gas & Elec., 6% pf.	107½	99½	107½
Columbia G. & E. com. $5—no par	96½	82¼	98¼
Columbia Ry., Gas & Elec., 6% pf.	m 98	97	100
Columbus Elec. & Pwr., $2 com.—no par	68	....	....
Columbus Ry., Pwr. & Lt., 6%, 1st pf.	104½	98¼	104
Columbus Ry., Pwr. & Lt., 6½% pf. B	103½	96	103½
Columbus Ry., P. & L., com.—no par	102	75	105
Commonwealth Edison, 8% com.	a164½	138	163
Commonwealth Pwr., 6% pf.	101½	91¼	103½
Commonw'th Pwr., $2, com.—no par	70½	48¼	78¾
Conn. Lt. & Pwr., 8% pf.	121	119	123
Conn. Lt. & Pwr., 7% pf.	117	112	118
Cons. Gas of N. Y., pf.	99½	93	100½
Cons. Gas of N. Y., com $5—no par	116½	94	121½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	k105	105	107
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	e113½	110¼	114¼
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	e115	112½	117
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	e127½	127	130½
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $2.50—no par	e 70	51	71
Consolidated Pwr. & Lt., 7% pf.	105	100	106
Consumers Pwr., 6% pf.	103¾	100	102
Consumers Pwr., 6.6% pf.	105½	103	105½
Continental Gas & Elec., 8% pfd. pf.	108	103	106½
Continental Gas & Elec., 7% pr. pf.	104	100	103
Conti. G. & E. com. $4.40—no par	k250	210	225
Crocker Wheeler, com.†	24	30	38
Crocker Wheeler, 7% pf.	81	78	88
DALLAS PWR. & LT., 7% pf.	109	107	110½
Dayton Pwr. & Lt., 6% pf.	107	101	107
Detroit Edison, 8% com.	155	133¼	160¾
Dubilier Condenser, com.—no par	4	2¼	5½
Duquesne Lt., 7% pf.	116½	114¼	116½
EASTERN NEW YORK UTIL., $7 pf.	107	102	104½
Eastern New York Util. com.	65	70	75
Eastern States Pwr., $7, com.	9	9	13
Eastern States Pwr., pf.	k 96	90	95
East. Tex. Elec., 7% pf.	106	106	108
Edison Elec. of Boston, $12 com.	d257	217	267
El Paso Elec., 7% pf.	110	105	107½
Elec. Bond & Share, 6% pf.	l108¾	105½	110¼
Elec. Bd. & Sh. Sec., com. $1—no par	l 76¼	67¾	80½
Electric Household Util.†	a 13	11	15½
Elec. Investors, 6% pf.—no par.	99	92	97
Elec. Investors, com.†—no par.	41½	32¾	42½
Elec. Investors, 10% pd. receipts	m 15	....	....
Elec. Pwr. & Lt., ctfs. pf.	106	96	106½
Elec. Pwr. & Lt., ctfs., 40% pd.	k118½	103¾	119
Elec. Pwr. & Lt., ctfs., full pd.	m114	108½	111¾
Elec. Pwr. & Lt., ctfs., com.—no par.	28½	16½	29½
Elec. Refrig. cap.†	11	9¾	37½
Elec. Ry. Securities, com.—no par.	6½	....	....
Elec. St. Battery com. $5.25—no par	70½	63¼	79½
Elmira Wtr., Lt. & R.R., 7% pf.	103	99	101½
Emerson Elec., pf.	m109	107½	111
Empire Pwr., pfd.†	35	....	....
Engr. Pub. Serv., $7 pf.—no par	107½	93¼	108
Engr. Pub. Serv., com.—no par	37½	21¼	39½
Eureka Vacuum Cleaner, com. $4—no par	73	50	77
FAIRBANKS MORSE, 7% pf.	k109	107½	112
F.-M., com.—$3—no par	35½	32	43½
Federal Lt. & Trac., com. $1.40	40	37½	47
Federal Lt. & Trac., $6 pf.—no par	j 98½	91½	100
Ft. Worth Pwr. & Lt., 7% pf.	l111	108	112
GALVESTON-HOUSTON ELEC. 6% pf.	78½	68	72
Galveston-Houston Elec., com.	35	26	32
Gen. Elec., $3 com.—no par	132¾	81	146¼
Gen. Elec., special—6%	11½	11	11½
Gen. Gas & Elec. (Del.) com. A. $1.50—no par	k 39½	34	47
Gen. G. & E. (Del.) com. B—no par	m 45	35½	44
Gen. G. & E. (Del.) pf. A. $8—no par.	k117½	113¾	120
Gen. G. & E. (Del.) pf. A $7—no par.	k110	100	110
Gen. G. & E. (Del.) pf. B $7	k103	96	105
Gen. Pub. Serv., $7 cum. pf., no par.	113	105½	113
Gen. Pub. Serv., com., no par	17	11½	18
Ga. Lt., Pwr. & Rys., 6% pf.	93	87	96
Ga. Lt., Pwr., & Rys., com.	m 50	50	80
Ga. Ry. & Pwr., 8% pf.	k125	119	125
Ga. Ry. & Pwr., 7% pf.	k113¾	106	110
Gt. Western Pwr., 7% pf.	h102½	....	..
IDAHO PWR., 7% pf.	106	103	109
Ill. No. Utilities, 6% pf.	k 96	88	97
Ill. Pwr. & Lt., 7% pf.	101	99	96½
Ingersoll Rand com. $8	89	88	96½
Int. Combus. Engr., com. $2—no par	47	43¼	64
Int. Util., Class A—$3.50—no par.	42½	28	45½
Int. Utilities, Class B—no par.	7½	3	7½
Interstate Pwr., pf.—$7—no par.	96½	93	98
Interstate Pub. Serv., 7% pf.	100	98	99½
Iowa Ry. & Lt., 7% pf.	97	97	99
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	104½	97½	105
Johns-Manville, com.†—no par.	119½	55½	123½

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, Oct. 15. lBid price Wednesday, Oct. 19. mLatest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday, Oct. 18	Low 1927	High 1927
KANSAS CITY PWR. & LT. pf.$7	116	112	116
Kansas Gas & Elec., 7% pf.	i107	103	107
Kentucky Hydro-Elec., 7% pf.	a 99	93¼	98
Kentucky Sec.,6% pf.	86	83	87
Kentucky Sec., 5% com.	109	110	115
Kentucky Utilities, 6% pf.	100	95	101
Keystone Pwr. & Lt., pf.	m98	95	100
LACLEDE GAS LT., 12% com.	k212	173¼	267½
Lehigh Pwr. Sec., com.—no par.	20½	15	21¼
Long Island Ltg., 7% pf.	111½	107½	114
Long Island Ltg. com.†—no par.	166	139	180
Los Angeles Gas & Elec., 6% pf.	102	98	104½
Louisville Gas & Elec., cl. A. $1.75	26¼	23¼	27¼
MAN. ELEC. SUPPLY, cap.—no par	49½	47	132
Manila Elec., com.†—no par.	59½	40	59½
Maytag Mfg., com. .50—no par.	32½	23¾	34½
Memphis P. & L., pf.—$7—no par	109½	107	109
Metropolitan Ed., pf.—$6—no par.	102½	93	100
Metropolitan Ed., pf.—$7—no par.	108	104	108
Metropolitan Ed., com. $5—no par.	75	60	72
Middle West Utilities, 7% pf.	a113	110¼	113½
Middle West Util., 8% pr. lien	a123½	117½	122½
Middle West Util., com. $6—no par	a113½	108	117½
Midland Utilities, pr. ln. 7% pf.	a105	97½	107½
Midland Utilities, 7% pf. A	a102½	96½	103½
Milwaukee Elec. Ry. & Lt., 7% pf.	k102	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	k 98½	98	101½
Minn. Pwr. & Lt., 7% pf.	i107	104	107
Miss. Pwr. & Lt., $8 pf.	m101	106	103
Miss. River Pwr. 6% pf.	103	94	104½
Miss. River Pwr. 3% com.	62	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par.	106	100	109
Mohawk Hudson Pwr., 2d pf.—$7—no par.	110	98	112
Mohawk Hudson Pwr., com.—no par	30	20½	32½
Montana Pwr., 7% pf.	m106½	118½	106½
Montana Pwr., 5% com.	109½	81½	109½
Montreal Pwr., 5% com.	f 92	....	....
Mountain States Pwr., 7% pf.	100	97	101
Mountain States pwr., com.†	18	....	....
NASSAU & SUFFOLK LTG., 7% pf.	107	98	110
National Carbon, 8% pf.	a138	130½	139½
National Elec. Pwr., A†	a 27½	22	26
National Lt., Ht. & Pwr., com.	24	....	....
National, Light, Ht. & Pwr., 5% pf.	70	....	....
National Pwr. & Lt., pf.—$7—no par	107	101	110
National Pwr. & Lt., com.†—no par.	24½	19½	26½
National Pub. Serv., 7% pf.	100½	93	100
National Pub. Serv., 7% ptc., pf.	113	108	115
National Pub. Serv., A com. $1.60—no par.	22½	18½	24
National Pub. Serv., B com.—no par	21¼	14	21½
Nebraska Pwr., 7% pf.	i110½	106	110
Nevada-Calif. Elec., com.	34	25	36½
New Brunswick Pwr., 4% pf.	60	....	....
New Eng. Pub. Serv., pr. ln. pf. $7..	101	98½	102
New Eng. Pub. Serv., pf. $7.	98	95	99
New Orleans Pub. Serv.—7% pf.	103	103	105½
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	90	91	97
N. Y. Central Elec., 7% pf.	102	101	104
Newport News & Hampton Ry., Gas & Elec., 5% com.	109	....	....
Newport News & Hampton Ry., Gas & Elec., 7% pf.	109	....	....
Niagara Falls Pwr., 7% pf.—25.	k 29	27½	29½
Niagara, Lock. & Ont. Pwr., 7% pf.	111	110½	113
No. Amer., 6% pf.—50.	53½	50	55
No. Amer., com.—10.	61	45½	64½
No. Caro. Pub. Serv., pf.—$7—no par	101	93	102½
Northeastern Pwr., com.	20	14½	20
No. N. Y. Utilities, 7% pf.	106	103	109
No. Ohio Pwr., com.—no par.	16½	9½	18½
No. Ohio Trac. & Lt., 6% pf.	83	78	81
No. Ont. Lt. & Pwr., 6% pf.	k 91½	84	95
No. Ont. Lt. & Pwr., 4% com.	72	73	78
No. States Pwr., (Del.) 7% pf.	108½	100½	109½
No. States Pwr., (Del.) 8% com.	130½	109½	133
No. Texas Elec., 6% pf.	65	65	70
No. Texas Elec., com.	25½	27	36
OHIO BRASS, com. B $4—no par.	94½	76	94½
Ohio Brass, 6% pf.	105	100	105
Ohio Pwr., 6% pf.	102½	96	103
Ohio Pub. Serv., $6 pf.	98½	95	96½
Ohio Pub. Serv., 7% pf.	107½	103	109
Ohio River Edison, 7% pf.	108	103	109½
Oklahoma Gas & Elec., 7% pf.	102½	...	....
PACIFIC GAS & ELEC., 6% pf.	26½	24½	26½
Pacific Gas & Elec., 8% new com.	42	31	45½
Pacific Pwr. & Lt., 7% pf.	i105	102	104½
Penn Cent. Lt. & Pwr., $5 pf.—no par	c 78	75½	78
Penn-Ohio Edison, 7% pf.	103½	97½	104½
Penn-Ohio Elec., 7% pf.	m102	99	103
Penn-Ohio Pwr. & Lt., 7% pf.	102	99	110
Penn. Pwr. & Lt.—$7—no par.	i109½	107	109
Penn Wtr. & Pwr., 8% com., new	c 71	47½	73½
Phila. Co., 6% pf.—50.	c 53.	49½	54
Phila. Co., com.—50.	118	85½	118
Phila. Elec., 8% com.—25.	c 54	46½	58½
Portland Elec. Pwr., 7% pf.	100	97½	101
Portland Elec. Pwr., 6% pf.	80	78	83
Portland Elec. Pwr., 6% 2d pf.	65	55	70
Portland Elec. Pwr., com.	27	22	30
Potomac Elec. Pwr., 6% pf.	m110½	....	....
Pwr. Corp. of N. Y., com. $1—no par	m 70	....	....
Pwr. Sec., pf.—no par.	k 43	28	45
Pwr. Sec. com.—no par.	k 12	5	15
Public Serv. of Colorado, 7% pf.	i102	99	102
Pub. Serv. of N. J., 6% pf.	k102½	98½	102½
Pub. Serv. of N. J., 8% pf.	k131½	125	132
P. S. of N. J., $2 com.—no par.	43½	32	46½
Pub. Serv. of No. Ill., 6% pf.	a107	101½	107
Pub. Serv. of No. Ill., 7% pf.	a116½	112½	117½
P. S. of No. Ill., com. $8—no par.	a153	140½	153
Pub. Serv. of No. Ill., $8 com.	a154	132	154
Pub. Serv. of Okla., 7% pr. ln.	k101	90	103
Pub. Serv. Elec. & Gas, 6% pf.	105	102	108½
Puget Sound Pwr. & Lt., 7% pr. pf.	109	103½	111
Puget Sound Pwr. & Lt., $6 pf.—no par.	88	....	....
Puget Sound Pwr. & Lt., com.	35½	28	38½
RADIO CORP. OF AMER., $3.50 pf.—50.	k 54	49	54½
Radio Corp. of Amer., com.—no par.	72½	41½	72½
Republic Ry. & Lt., pf.	m120	....	....
Republic Ry. & Lt., com.	m135	112	135
Rochester Gas & Elec. 6% pf. D.	104½	103½	104½
Rochester Gas & Elec., 7% pf. B.	104	105	107
Rochester Gas & Elec., 6% pf. C.	k104½	101½	103½
SAFETY CABLE, com. $4.	68	52½	74½
San Joaquin Lt. & Pwr., 7% pr. pf.	106	105	108
St. Joseph Ry., L., H. & P., 5% pf.	72	70	73
Servel Corp.	54cts	50cts	10½
Sierra Pacific Elec., 2% com.	28½	24½	31½
Sioux City Gas & Elec., 7% pf.	104½	99	105½
Southeastern Pwr. & Lt., pf.—$7 no par	i107	....	....
Southeastern Pwr. & Lt. ptc. pf.	i 82½	....	....
Southeastern Pwr. & Lt., com.—no par	38½	29½	40
So. Calif. Edison, 8% pf.	39	36½	40
So. Calif. Edison, 7% pf.	k 28	27½	28½
So. Calif. Edison, 6% pf.	k 25	24½	27
So. Calif. Edison, 8% com.	39½	31½	41
Southern Cities Utilities, 7% pf.	k 80	67	90½
Southern Cities Utilities, com. $4.	a 32	25½	33
Southwestern Lt. & Pwr., A $3.	63	60	65
Southwestern Lt. & Pwr., B.	63	60	65
Southwestern Lt. & Pwr., $6 pf.	86	83	91½
Southwestern Pwr. & Lt., 7% pf.	111½	104	111½
Springfield (Mo.) Ry. & Lt., 7% pf.	102½	95	102
Standard Gas & Elec., 8% pf.	64½	57½	65½
Standard Gas & Elec., 7% pr. pf.	110½	103	112
Standard G. & E., com. $3.50—no par.	62½	54	65½
Standard Pwr. & Lt., 7% pf.	100	98½	102
Staten Island Edison, pf.—$6—no par.	101½	99	101
Superheater, $6 com.—no par.	176	170	185
Syracuse Lighting, 7% pf.	110	103	107
Syracuse Lighting, 8% pf.	120	....	
Syracuse Lighting, 8% com.—no par	m300	....	....
TAMPA ELEC., com. $2.	63	....	....
Tenn. Elec. Pwr., 6% pf.	100	92	100
Tenn. Elec. Pwr., 7% pf.	107½	103	109
Terre Haute, Ind. & East. Trac., 5% pf.	26	20	30
Terre Haute, Ind. & East. Trac., com	1	1	3
Tex. Pwr. & Lt., 7% pf.	i111	106	111½
Tide Water Pwr., 8% pf.	109	105	110
Timken Roller Bear., com.—$4 no par.	119	78	142½
Toledo Edison, 8% pf.	m114	115	118
Toledo Edison, 7% pf.	i107	102	107
Toledo Edison, 6% pf.	k 98½	95	97
Toledo Edison, 6% com.	98	....	....
Tri-City Ry. & Lt., 6% pf.	96½	96	99
UNITED GAS & ELEC., 6% pf.	101	98	102
United Gas & Elec., com.—no par.	m 57	....	....
United Gas & Elec. (N. J.) 5% pf.	72	70	73
United Gas Impr., 8% com.—50.	c 109	89½	118½
United Lt. & Pwr., pf.—$4—no par.	a 55	50	57
United Lt. & Pwr., pf.—$6.50—no par.	a 95	87	97½
United L. & P., com. A .48—no par.	15	12½	15½
United L. & P., com. B .48—no par.	m 19½	15	24
Utah Pwr. & Lt., 7% pf.	i107½	104	108½
Utica Gas & Elec., 7% pf.	105	105	106½
Utica Gas & Elec., 8% com.	200	....	....
Utilities Pwr. & Lt., 7% pf.	96½	93	100
Utilities Pwr. & Lt., com. A $2.	30½	27	34
Utilities Pwr. & Lt., com. B $1—no par.	21½	13½	22½
VERMONT HYDRO-ELEC., 7% pf.	99	95	100
Virginia Elec. & Pwr., 7% pf.	108	105	110
Virginian Pwr., 7% pf.	108	....	....
Virginian Pwr., com.	75	....	....
WAGNER ELEC., 7% pf.	m87	68	90
Wagner Elec., com.—no par.	b 29½	18½	30½
Washington Ry. & Elec., 5% com.	355	....	....
Washington Ry. & Elec., 5% pf.	98½	....	....
Washington Wtr. Pwr., 8% com.	164	136	182
West Penn Elec., 7% pf.	111½	102	112½
West Penn Elec., Cl. A $7.	107½	97½	110
West Penn Pwr., 7% pf.	115	111	118
West Penn Pwr., 6% pf.	107½	100½	108½
West Virginia Lt., Ht. & Pwr., 7% pf.	95	94	100
West Va. Utilities, 7% pf.—50.	m 95	48	51½
Western Pwr., 7% pf.	k103	98	101½
Western States Gas & Elec., 7% pf.	k103	96	105
Western States Gas & Elec., com.	m 38	....	....
Westinghouse Elec. & Mfg., 8% com.—50.	82½	67½	89½
Weston Elec. Instrument, Cl. A $2—no par ex.div.	k 30½	30	34½
Weston Elec. Instrument, com.—no par.	k 12½	11	18½
Wheeling Elec., 6% pf.	102	95	104
Worthington Pump, 7% pf. A.	k 45	46	61½
Worthington Pump, 6% B.	40	40	54½
Worthington Pump, com.	29	20½	46
YALE & TOWNE com. $5—25.	80	70½	84½

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; f Montreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, Oct. 15. lBid price Wednesday, Oct. 19. mLatest quotations available. †Dividend rate variable.

ment has been the multiplication of uses for energy, resulting in the prosperity of the industry with which we are all familiar. It should be noted, however, that while such a thing as a saturation point is hardly thought of, it is becoming increasingly necessary to pursue the intensive sales methods of industrial enterprises. Careful attention is now being directed to the form of rate schedules so as to encourage still further consumption in spite of the fact that present rates are generally low and, viewed from the standpoint of the purchasing power of the dollar have declined almost continuously since the inception of the industry. In 1926 the average domestic revenue per kilowatt-hour was 7.4 cents, which is the equivalent of 4.2 cents of the 1913 dollar. The average revenue per kilowatt-hour for the entire industry was 2.3 cents in 1926, the same as it was in 1913. While wholesale commodity prices in 1921 were 126 per cent higher than in 1913 and are still 50 per cent higher, the average rate for energy in 1921 reached a peak of only 6 per cent above 1913 rates and in 1926 had returned to the 1913 level.

"In its constant search for wider usefulness, the industry has recently devoted itself seriously to rural electric service. Until a few years ago rural service was unprofitable on account of the scattered distribution of the customers and their use of energy for lighting only. However, elaborate experimentation in some 22 states has produced data which demonstrate that under certain conditions, based on regarding the farm as a factory as well as a home, the consumption of energy can be increased to a point where the business is profitable to the electric company, at prices which encourage use of energy by the customer. At the present time more than one hundred practical uses of electricity for farm work have been developed, and in three years' time, under the new conditions, the number of farms supplied with electric service has increased over 86 per cent. In 1926 there were 227,500 farms in 27 states using electricity. The rate of increase in the number of users and the as yet untouched possibilities in the field are significant."

In closing his report, Mr. Seybold said: "The utility industry, generally recognized as a sound field for investment, has offered opportunities to the investment banker in the underwriting and distribution of securities. So constructive has been the association of the investment banker in the development of the utility industry from its early status that he must continue to share the responsibilities with the opportunities. His co-operation should be extended, not only in the rôle of aiding the industry against unwarranted attacks from without, but also to the prevention of any abuses of exploitation from within."

Business News and Market Conditions

Construction Contracts at High Level

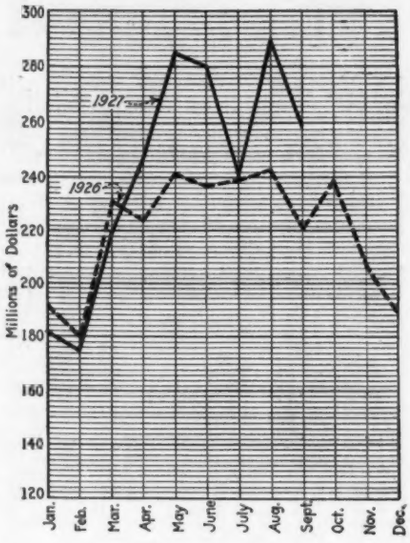
Record Year Indicated by Total to Sept. 1, 1927—September Gains Compared with Those of a Year Ago

ENGINEERING construction contracts let so far this year indicate that 1927 will hold the record. Up to Sept. 1, 1926, the total for the United States was $2,176,518, which compares with $2,368,960 for the same period in 1927, according to the *Engineering News-Record*. In the figures given in the accompanying table only contracts of major importance are included. These comprise all awards valued at $15,000 and over on waterworks and excavation, drainage, irrigation, levee, river and harbor projects; $25,000 for other public works, $40,000 for industrial, and $150,000 for commercial, educational, institutional, religious and other buildings.

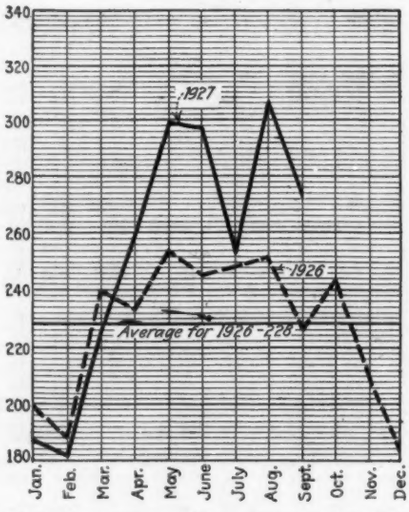
The gain of 17 per cent in money value of September awards, compared with the same month last year, is accentuated by the fact that materials prices were substantially lower. Every section of the country except New England showed a gain last month compared with September, 1926. The normal seasonal variation in September contract letting (money value) over a period of fourteen years, 1913 to 1926, has been about 0.4 per cent gain over August. The normal condition of contract letting over a period of five years, 1922 to 1926, has been one where no marked change occurred between the September total and that of the month preceding.

While September shows substantial gains over the same month last year, average weekly lettings should have been at least 10 per cent heavier in order to bring the month up to its seasonal volume. September gains compared with a year ago were largely in public work. Commercial buildings, the only privately owned class of construction to show a gain, increased 20 per cent compared with September, 1926. Public buildings and federal government work were just about even with September of last year. Streets and roads gained 42 per cent. Bridges and excavation projects (publicly owned) more than doubled the September, 1926, volume, while three times more public work of unclassified nature was awarded in September, 1927.

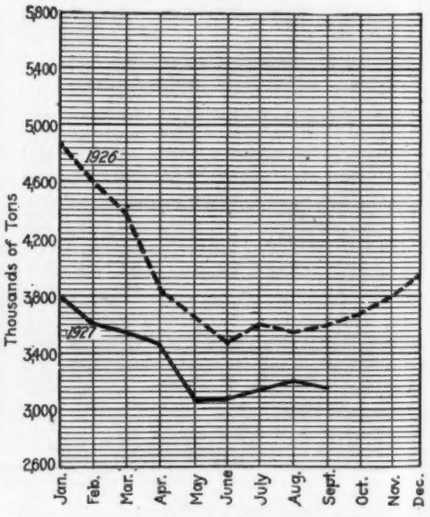
While all sections except New England gained, comparing September with the same month last year, the states responsible for the increases appear as follows: Middle Atlantic—New Jersey, Pennsylvania, Maryland and Delaware; South—Virginia, West Virginia, South Carolina, Georgia, Alabama, Mississippi, Kentucky and Tennessee; Middle West—Indiana, Illinois and Michigan; west of the Mississippi (between the river and the Rockies)—Iowa, Arkansas, North Dakota, South Dakota, Oklahoma, Texas, Wyoming and Colorado; Far West—Idaho, Arizona, Nevada and Washington. Vermont showed the only increase in New England.



CONTRACTS AWARDED IN THE UNITED STATES



CONSTRUCTION VOLUME AS COMPARED WITH AN INDEX OF 100 FOR 1913



UNFILLED TONNAGE AS REPORTED BY THE UNITED STATES STEEL CORPORATION

In the chart at the left the actual volume of construction is compared and not the mere money value of contracts let. (*Engineering News-Record* statistics.)

Value of Contracts Let in the United States and Canada During September, 1927

(Thousands of dollars—000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Date, U. S.	Canada
Water-works	$695	$701	$158	$584	$817	$169	$3,124	$44,337	$1,792
Sewers	199	1,225	880	4,576	1,452	1,812	10,144	87,325	187
Bridges	758	3,916	9,531	2,940	5,215	330	22,690	102,381	.....
Excavations, drainage, etc.	53	99	1,380	820	102	69	2,523	36,843	1,428
Streets and roads	2,844	15,939	11,678	21,319	18,782	7,451	78,013	412,198	1,204
Industrial buildings	2,638	4,025	4,290	5,288	6,033	2,377	24,651	1[illegible],617	1,945
Commercial buildings	16,651	44,577	4,385	63,854	17,692	19,975	167,134	1,215,456	2,460
Federal government	68	371	1,794	454	934	1,568	5,189	37,317	.....
Unclassified	1,814	2,113	230	244	3,157	2,961	10,519	235,486	3,106
September, 1927	$25,720	$72,966	$34,326	$100,079	$54,184	$36,712	$323,987	$2,368,960	$12,122
August, 1927	20,430	83,025	25,843	73,773	51,095	35,178	289,344	.....	13,227
September, 1926	33,620	70,027	24,354	63,210	52,341	32,905	276,457	.....	8,254
January 1 to date, 1927	188,229	697,201	185,630	596,687	416,063	285,150	2,368,960	.....	88,537
January 1 to date, 1926	189,290	662,994	226,625	533,042	338,882	225,685	2,176,518	.....	95,096

NOTE.—Owing to five weeks of construction contracts being included in some months, as in September, the figure for the total contracts let, as shown in the table, does not agree with the figure as represented in the curve. In order to obtain comparable figures the curve is worked out on a four-week basis for each month.

The construction volume index number for the month of September was 273. This compares with 228 for the whole of 1926 and 100 for 1913. This means that the actual volume of contract letting in September, 1927 (not the mere money value of the contracts let), is 173 per cent above the volume for 1913. The index number contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards. In August, 1927, the record was reached when the index number was 306.

The demand for the principal construction materials in the first nine months of 1927 was 8 per cent greater than that for the corresponding period last year, as shown by the contract totals given in the table. The cost of these materials together with that of labor, taking an average for the period from Jan. 1 to Oct 1, 1927, is 0.2 per cent under the average for the same months in 1926. The present direction of the market for basic materials is downward. This movement is largely seasonal and applies to the country as a whole, since several price advances of a local nature have developed during the last thirty days. Materials in which definite price fluctuations have occurred, in the order of importance, are pig iron, cement, cast-iron pipe and steel.

For Co-operative Industrial Research Work

Setting a precedent for other industries that could profit by placing industrial research beyond the reach of the vicissitudes of trade association fortunes and interests, the tanning industry has set aside a fund of $1,000,000 for the permanent endowment of leather research, according to an announcement made by Fraser M. Moffat, secretary of the Tanners' Council of America, 41 Park Row, New York. The fund will insure the continuous and effective operation of the independent foundation incorporated last May for tanning research. The corporation, known officially as the "Foundation of the Research Laboratory of the Tanners Council of the United States of America at the University of Cincinnati, Inc.," has taken over the leather research work conducted at the University of Cincinnati.

Market Conditions

GENERAL activity continues in the electrical industry virtually throughout the country. Industrial activity is particularly prominent in the Southeast, and several large industrial projects are under way on the Pacific Coast. Optimism prevails in the Middle West, largely owing to the excellent grain crop and the effect it has already had on the buying power. Statistics show that the 1927 yield of corn will be better than anticipated, and a much better feeling is apparent. For instance, in Nebraska merchandise sales of a large power company are 81 per cent higher than they were last year, and it is anticipated that 1927 sales in that territory will be considerably ahead of those last year.

In New England small orders mark the sales in the district and consist mainly of requirements for power plants and substation extensions. Sales from Jan. 1 to date in that district are ahead of those for the same period last year. Power-company orders show an increase in the New York district and are mainly for transformers and substation apparatus. In the Southeast industrial activity is brisk, new plants are being constructed and several extensions to textile plants are planned. A good deal of high-tension line construction is also under way. Sales are diversified and in good volume in the St. Louis district. Manufacturers are looking forward to a good business for the rest of the year. Substantial business was transacted in the Middle West and greater activity is anticipated. Construction work is slow but industrial business is improving. On the Pacific Coast orders for $600,000 worth of transformers were placed by the Southern California Edison Company, and the purchase of an additional $200,000 worth is under consideration. Several large industrial projects covering pulp and paper mills are in the formative stage, and inquiries will soon be made for prices on the necessary apparatus.

Copper Sales Largest in Eight Months—Lead Active

Extremely heavy copper sales were consummated in the non-ferrous metal market following many weeks of dullness. A large tonnage of lead has also been booked, particularly in the Middle West, where prices have advanced. After having resolutely held out for 13¼ cents for many weeks without getting much of any business at that level, copper sellers without exception found buyers willing to pay that price last week. An extremely heavy tonnage was sold on that and the two succeeding days, partly at 13¼ cents delivered in the East, and some at 13⅜ cents in the Middle West. An important brass manufacturer placed a large order, but buying by brass and wire mills and sheet copper manufacturers was general, with some demand also from the automobile industry. The three days of

Delinquent Electrical Accounts

(Data Supplied by National Electrical Credit Association)

NUMBER OF ACCOUNTS REPORTED

Division	September 1926	September 1927	Per Cent Increase or Decrease	Nine Months 1926	Nine Months 1927	Per Cent Increase or Decrease
New York	342	228	—33.3	3,361	2,859	—15
Middle and Southern Atlantic States	165	206	+24.8	1,713	1,548	— 9.75
New England	101	155	+53.4	822	1,404	+70.8
Pacific Coast	27	13	—51.8	225	152	—32.6
Central	784	718	— 8.42	7,962	8,223	+ 3.28
Total	1,419	1,320	— 6.98	14,083	14,184	+ .72

TOTAL AMOUNTS REPORTED

Division	September 1926	September 1927	Per Cent Increase or Decrease	Nine Months 1926	Nine Months 1927	Per Cent Increase or Decrease
New York	$51,780	$31,186	—39.7	$493,179	$451,557	— 8.44
Middle and Southern Atlantic States	20,820	20,806	— .07	200,114	182,248	— 6.62
New England	8,293	20,213	+143.7	77,539	164,102	+111.6
Pacific Coast	1,349	1,233	— 8.60	34,302	18,999	—44.6
Central	102,339	71,593	—30	279,501	915,295	+ 4.07
Total	$184,581	$145,031	—21.4	$1,684,635	$1,732,799	+ 2.66

AVERAGE AMOUNTS

Division	September 1926	September 1927	Nine Months 1926	Nine Months 1927
New York	$151	$137	$1,314	$1,426
Middle and Southern Atlantic States	126	101	989	1,068
New England	82	130	863	1,053
Pacific Coast	50	94	1,343	1,401
Central	131	100	998	1,004

Note: A sharp increase is recorded in accounts reported by the New England division. This is owing to increased association activity in that section and not to adverse economic conditions.

NEW YORK METAL MARKET PRICES

	Oct. 12, 1927 Cents per Pound	Oct. 19, 1927 Cents per Pound
Copper, electrolytic	13.20	13
Lead, Am. S. & R. price	6¼	6¼
Antimony	11	11¼
Nickel, ingot	35	35
Zinc spots	6.45	6.35
Tin, Straits	58	58¼
Aluminum, 99 per cent	26	26

Base copper price Oct. 19, 1927, 15¼ cents.

this week, have been much quieter and concessions in price were made. The zinc market has been slow. Lead sellers have enjoyed an unusually active week although inquiry on Wednesday showed a decrease.

Small Orders Mark Sales in the New England District

Many small orders covering in the main requirements for power units and substation extensions were placed in the New England district. One manufacturer reports receiving a number of inquiries for outdoor substation extensions, one of which, amounting to about $2,000, was placed in Maine, and a number of others of interest are to be placed soon. Orders for small transformers, switches and control equipment are encouraging. Sales in the district since Jan. 1 are ahead of those for the same period last year. New construction requirements consisting of hardware, wiring devices, wire and cable, are leading in interest. No orders for large power equipment have been recorded, and small-motor sales continue on an even trend with a number of group orders for fractional sizes having been received from oil-burning equipment manufacturers.

Electric heating furnaces are receiving attention. A manufacturer who has developed a new type of high-heat furnace for high-speed alloy tool steels reports increasing interest in the locality and records orders ahead for two months' work at capacity, with business showing about a 10 per cent increase in volume as compared with last year. In Rhode Island active interest is shown in electric ranges. Sales of more than fifty ranges are reported in that district in the past six weeks. At a recent Rhode Island Electric League show over 50,000 people in attendance indicated an encouraging interest in electrical appliances. Appliance sales are ahead of those last year, with portable lamps, irons and table appliances in good demand.

The Business Men's Association of New Britain, Conn., has appointed a committee to plan for the better lighting of the business section. Another New England project planned by the Stamford Gas & Electric Company covers the construction of a substation on South Street, Stamford.

Power Companies Active in New York District

Sales to central-station companies in the New York district show some improvement, although orders are generally limited to small amounts and no large projects are indicated by current business. Numerous inquiries are being received for transformers and substation apparatus, and there is an increasing demand for switching equipment and circuit breakers. Poles, crossarm and hardware sales are quiet. The demand for motors and control apparatus among industrial buyers is off, and manufacturers report that sales of motors are somewhat less than they were last month. Jobbers find a good market for appliances, but the demand for fixtures, conduit, etc., is spotty. The quartermaster, Second Corps Area, Governors Island, New York, is asking for bids until Nov. 2, for electric generators and engines of the Diesel type, the engines to drive 20-kw. generating units. Hugh L. Cooper & Company, New York, are working on a proposed hydro-electric power development on the Columbia River, Pend Oreille County, Wash., to consist of power dam and initial generating equipment for a capacity of 500,000 hp.

Industrial Activity Brisk in Southeast

A satisfactory volume of small orders with few individual large orders for electrical supplies have been placed in the Southeast. One company placed an order, amounting to $4,228, for switching equipment. Another central-station company placed orders for meters amounting to approximately $10,000. Owing to industrial activity in the Southeast a demand has been created for line material for the construction of high-tension lines. Several large orders have been placed for creosoted pine poles and for cables.

The city of Atlanta has opened bids covering the lowering of the railroad tracks incident to construction of the Central Avenue and Pryor Street viaducts. The building of these viaducts will involve considerable changes in the overhead and underground electric distribution system and will create a demand for this class of supplies. The General Motors Company, Detroit, has announced the construction of a plant in Atlanta to assemble Chevrolet motor cars and Fisher bodies. This represents an investment of approximately $1,500,000 and will require electrical equipment amounting to approximately $50,000. There is continued activity in the textile industry, several mills announcing extensions to present plants.

Substantial Sales Reported in Middle West

Fall business in the Middle West is shaping up well. The volume transacted is quite substantial and greater activity is anticipated. Construction work is admittedly slow but industrial activity is improving. Reports from agricultural sources indicate a healthy condition, the number of persons unemployed is decreasing steadily, and there is every reason to feel optimistic. The various utility companies, through steady demands for construction and maintenance materials, are doing much toward the improvement of general conditions. Among the interesting items ordered were three 12,000-volt grounding transformers, four 6,000-amp., 12,000-volt reactors, four 150-kva. and four 37½-kva. single-phase 2,300-volt distribution transformers, 60 current transformers, 650 direct-current watt-hour meters, 10-amp. to 3,000-amp. capacity, 7,000 5-amp. watt-hour meters and 4 tons of magnet wire.

Jobbers' sales are increasing. Ventilation equipment sales together with industrial blowers are appreciably good. Quite a demand for small motors was noticeable, one jobber entering a single order for 500 ½-hp. motors. Appliance sales continue good. The Goodrich Tire & Rubber Company, Akron, Ohio, is having plans prepared for a proposed one-story power plant 88 ft. by 135 ft., reported to cost more than $100,000, with equipment. The Condon Engineering Company, Chicago, has plans in preparation for a proposed steam-operated central power plant at Sebree, Ky., reported to cost in excess of $150,000, with transmission system.

Large Transformer Order Placed on Pacific Coast

An outstanding order on the Pacific Coast covered approximately $600,000 worth of transformers comprising an assortment of 250-kva. to 7,500-kva. transformers for the Southern California Edison Company. An additional purchase of 6 25,000-kva. transformers valued at about $200,000 is also under consideration. An order for 8 assorted transformers, sizes 7,500 kva. to 10,000 kva. was placed in San Francisco for San Joaquin Valley service. Another excellent machinery order covers the elevator electrical equipment for a San Francisco hotel comprising 6 motors and 6 motor generator sets for variable voltage control, totaling $300,000. The initial order for the electrification of an Hawaiian sugar plantation has been placed and amounts to $7,500.

Three carloads of suspension insulators, valued at $22,000, have been ordered in San Francisco to be used in maintenance work along 110,000-volt lines in the Sacramento and upper San Joaquin valleys. An unusual order covers 300 assorted fans, valued at $6,000, purchased by a San Francisco jobber because of exceptionally warm October weather. Lumber companies are buying briskly, their orders and inquiries covering mainly wire and cable.

Specifications are being written or are now out on several projects on the Puget Sound providing for pulp, paper and lumber mill installations also for a four-million-gallon daily capacity pumping plant in Spokane. Bids are being taken for refrigeration equipment and motors for a Seattle high school and for similar equipment for the State School For Deaf and the State Reformatory. The town of Morton, near Tacoma, has passed an ordinance providing for an election to vote a $20,000 issue for the construction of a transmission and distribution system in addition to a $40,000 issue already voted. The Cascade Power Company has filed application for a permit for a proposed 60,000-hp. development on the Wenatchee River, Chelan County, near Leavenworth, Wash.

Construction plans on the Pacific Coast are as follows: The city council, Beaver City, Utah, is having plans prepared for extensions and improvements in the municipal electric power plant, to cost about $30,000; the Truckee River Power Company, Reno, Nev., has approved the construction of a new transmission line from its Washoe generating station to the Reno city limits, to cost approximately $85,000; the Board of Trustees, Turlock Irrigation District, Turlock, Cal., has authorized plans and surveys for the construction of a transmission line from Don Pedro power station to Merced Falls, about 14 miles, where power will be delivered to the San Joaquin Light & Power Company and the Aztec Light & Power Company, Aztec, N. M., is planning the rebuilding of its power plant recently destroyed by fire with loss reported in excess of $40,000.

Sales Diversified and Volume Good in St. Louis District

Electrical sales has been quite diversified in the St. Louis district, although no sales of machinery worthy of note have been reported. An order for a switchboard costing $3,000 was placed by a company in the western part of the district, and another for switchboard and substation equipment amounting to $25,000 was booked for a large operating company for installation southwest of St. Louis. The increasing loads caused by shortening days have resulted in some very good orders for all kinds of line material. Manufacturers have reported business somewhat below normal, but a survey of the situation shows inventories to be near an irreducible minimum and competition very keen. All electrical men are optimistic and are looking forward for the next six weeks to a business that will bring the average above last year.

Construction projects reported for the territory are as follows: The Board of Public Service, St. Louis, is asking for bids until Nov. 1, for electrically and hand-operated gate valves for municipal pumping station service; the City Council, Fairbury, Neb., is having preliminary plans prepared for a proposed municipal steam-operated electric power plant, reported to cost close to $50,000, and the City Council, Bridgeport, Neb., has made preliminary plans for a municipal hydro-electric power plant on the Belmont Canal near the city, estimated to cost about $100,000, with transmission line, and has made application to the State Bureau of Drainage & Irrigation for permission to proceed with the work.

Activities of the Trade

Five Wire Companies Plan Consolidation

Directors Ask Stockholders to Approve Details — Fourteen Plants in Combination to Be Known as the General Cable Corporation

THE General Cable Corporation, which will have net assets of $50,000,000, is contemplated under a merger of five important electrical wire and cable manufacturing companies. The directors of the five companies have mailed letters to their respective stockholders setting forth plans for the formation of a single company. The new company will own the assets and businesses now operated by the Dudlo Manufacturing Corporation, the Rome Wire Company, the Safety Cable Company and the Standard Underground Cable Company, as well as the sheet, rod and wire mills of the Baltimore Copper Smelting & Rolling Company. The directors have called the stockholders to special meetings scheduled on or about Nov. 10, when they are expected to ratify the actions of the boards with respect to arranging the merger details.

The General Cable Corporation will have plants at Bayonne, Perth Amboy, Newark and Harrison, N. J.; Rome and Buffalo, N. Y.; Pawtucket, R. I.; Baltimore, Chicago, Pittsburgh, St. Louis, Fort Wayne, Ind; Oakland, Cal., and Hamilton, Ontario, and will thus have strategic locations in the principal industrial areas of the United States and Canada.

Based on 80 per cent of the appraised sound values of these plants, adjusted to June 30, 1927, and after deducting all current liabilities and reserves, the net assets of the consolidated company as of June 30 amount to more than $50,000,000. Of this total, $22,000,000 and more consist of net quick assets, such as cash accounts receivable, inventory and other liquid accounts. The corporation will manufacture all kinds of copper wire and cables, from the finest of enamel wire for delicate electrical instruments to the largest cable for aërial and underground service. It will also manufacture brass and bronze wires, tubing, copper rods and sheets, and by the balanced operation of its plants will be able to produce a long line of products with considerable saving in costs and economy in production.

All of the special and secret processes owned by any one of the merged companies will henceforth be available to all the plants of the new corporation and it is planned to put into operation at each unit all the best practices derived by research and development at any one of the plants. The company will also own a number of well-located warehouses which will make rapid service and transportation economies possible. The General Cable Corporation expects to retain the executives and staffs now managing the various plants, and trade names and good-will will also be perpetuated.

The capitalization which will be outstanding at the completion of the merger will consist of $16,000,000 first mortgage 5 per cent bonds, $15,000,000 par value of 7 per cent preferred stock and about 400,000 shares of class A stock and 440,000 shares of common stock. All the classes of stock will carry voting power. The preferred stock to be issued will carry warrants allowing the purchase of additional class A stock, and all the class A stock will be convertible into common. Dillon, Read & Company and Kissel, Kinnicutt & Company are the bankers for the new corporation and will handle the financing.

THE TRUMBULL-VANDERPOEL ELECTRIC MANUFACTURING COMPANY, Bantam, Conn., manufacturer of safety switches has appointed C. Dent Slaughter Pacific Coast representative, with offices in San Francisco, Los Angeles, Portland and Seattle. The company has also appointed Alexander Craig, formerly industrial specialist with the Morris Blumberg Electric Company, electrical jobber of Detroit, as district sales manager for the state of Michigan.

General Electric Shows Increasing Profits

The General Electric Company billed sales amounting to $225,959,611 in the first nine months of 1927, according to an announcement by Gerard Swope, president. This compares with $229,638,216 in the same period of 1926. The profit available for dividends on the common stock for the nine months was $33,262,241, or $4.61 a share, against $30,051,620, or $4.17 a share, a year ago.

Statements of sales and earnings for the nine months of each year are as follows:

	1927	1926
Net sales billed	$225,959,611	$229,638,216
Less: Cost of sales billed, including operating, maintenance and depreciation charges, reserves and provisions for all taxes	198,796,918	203,690,909
Net income from sales	$27,162,693	$25,947,307
Other income, less interest paid and sundry charges	8,030,362	5,818,365
Profit available for dividends	$35,193,055	$31,765,672
Less: Cash dividends on special stock	1,930,813	1,714,052
Profit available for dividends on common stock (7,211,481 84/100 shares issued)	$33,262,241	$30,051,620

Electrical Patents

Announced by U. S. Patent Office

(Issued Sept. 27, 1927)

1,643,600. ELECTRIC ANNEALING HOOD; T. F. Baily, Alliance, Ohio. App. filed March 18, 1924.

1,643,634. ELECTRIC SWITCH GEAR; E. Waterhouse, South Shields, England. App. filed Dec. 23, 1926.

1,643,641. ELECTRIC LAMP SOCKET; N. B. Parsons, La Grange, Ill. App. filed July 7, 1922. Suitable for dental purposes.

1,643,655. ELECTRIC SOCKET; I. F. Giles, Yonkers, N. Y. App. filed Sept. 26, 1925. Of molded electrical insulating material.

1,643,656. ELECTRIC LAWN MOWER; P. S. Haselton, Bayside, N. Y. App. filed Oct. 1, 1925.

1,643,658. CORD LOCK; F. F. Hillix, Cleveland, Ohio. App. filed Dec. 16, 1922. For extension cords; to take the strain off the connection between the wires of the cord and the terminals.

1,643,659. CONNECTOR FOR ELECTRIC CONDUCTORS; F. F. Hillix, Cleveland, Ohio. App. filed April 20, 1923. A series tap connector.

1,643,673. ELECTRIC HEATING ELEMENT; W. C. Merrill, Alameda, Cal. App. filed June 2, 1926. Of the plug type adapted for insertion into the casing and water space of an electric water heater.

1,643,697. LIGHTING APPARATUS; F. W. Christy, Beverly, Mass. App. filed Oct. 29, 1925. For use on benches of factories, machine shops and the like.

1,643,734. THERMOCOUPLE; V. K. Zworykin, Kansas City, Mo. App. filed June 19, 1922. A thermocouple structure comprising a continuous strip of conducting material arranged in the form of a zigzag coil and in a substantially annual outline, alternating semi-convoltions of the coil being provided with applications of metal of different resistance properties from the conducting material.

1,643,751. TROLLEY POLE; S. Pulaski, Brooklyn, N. Y. App. filed Feb. 15, 1927.

1,643,755. RAIL BOND; T. G. Stiles, Arlington, N. J. App. filed July 2, 1921.

1,643,759. ALARM CIRCUIT OPERATED BY MICROPHONE; T. C. Adams, Minneapolis, Minn. App. filed Sept. 21, 1925.

1,643,768. SAFETY SWITCH; H. J. L. Frank, Detroit, Mich. App. filed May 5, 1922.

1,643,773. ELECTRODE FEEDING MEANS; W. B. Jaspert, Wilkinsburg, Pa. App. filed June 3, 1921. For electric arc welding.

1,643,774. ELECTRIC FURNACE; A. D. Keene, Pittsburgh, Pa. App. filed Feb. 10, 1925. Muffle furnace.

1,643,778. AUTOMATIC CIRCUIT BREAKER FOR ELECTRIC KEY PUNCHES; W. W. Lasker, Brooklyn, N. Y. App. filed April 29, 1925.

1,643,783. APPARATUS FOR WAVING HAIR; F. R. Marcel, Brooklyn, N. Y. App. filed Sept. 18, 1923.

1,643,784. METERING PANELBOARD; A. C. McWilliams, Chicago, Ill. App. filed Oct. 28, 1922.

1,643,785. DYNAMO-ELECTRIC MACHINE; S. G. Nottage, Murraysville, Pa. App. filed May 25, 1925. Alternating-current commutator machines provided with compensating windings for neutralizing the magnetic effect of the armature currents.

1,643,789. KNIFE-BLADE SWITCH; W. H. Siemon, Wilkinsburg, Pa. App. filed Oct. 4, 1922.

1,643,790. ELECTRIC LAMP SOCKET; H. E. Slade, Newark, N. J. App. filed Dec. 7, 1923. Keyless type.

1,643,792. THERMAL SWITCH; B. H. Smith, Wilkinsburg, Pa. App. filed Jan. 24, 1921.

1,643,798. SWITCH MECHANISM; H. G. Baxter, Wilkinsburg, Pa. App. filed April 18, 1922. Safety type adapted for use in mines.

1,643,806. ELECTRIC SWITCH; D. R. Davies, Manchester, England. App. filed Feb. 1, 1924. Oil-break switch.

1,643,808. ELECTRIC FURNACE; F. A. J. Fitzgerald, Niagara Falls, N. Y. App. filed June 1, 1925.

1,643,810. GAS-FILLED INCANDESCENT LAMP AND GETTER THEREFOR; D. S. Gustin, Newark, N. J. App. filed May 16, 1923.

1,643,843. ALARM-CLOCK SWITCH; J. G. Goodhuem, Evanston, and H. J. Sanvage, Chicago, Ill. App. filed Jan. 3, 1925.

1,643,852. ELECTRIC TIME-ELEMENT DEVICE; F. N. Linstow, Hebburn-on-Tyne, England. App. filed April 12, 1924.

1,643,875. DROP HAMMER; M. W. Cole, Richmond, Va. App. filed June 19, 1925. In which the reaction of a pair of energized coils is used to produce the lifting power for raising the hammer, wherein the arrangement of the coils is such that the reactive power becomes substantially neutralized at the top of the stroke of the hammer.

1,643,894. MULTIPLE SWITCH; R. Law, Woodside, N. Y., and E. J. Sweda, Glendale, N. Y. App. filed Sept. 11, 1926. Of the push-and-turn-button type.

1,643,900. ELECTROLYZER ELECTRODE OF THE FILTER-PRESS TYPE; R. Pechkranz, Geneva, Switzerland. App. filed March 9, 1927.

1,643,929. MANUAL HOLDER FOR ARC-WELDING ELECTRODES; A. Marland, Conshohocken, Pa. App. filed Sept. 29, 1925.

(Issued Oct. 4, 1927)

1,643,943. INSULATOR SUPPORT; C. Christensen, Chicago, Ill. App. filed Oct. 4, 1920. Clamps for mounting busbars and similar apparatus.

1,643,949. METHOD OF TESTING BATTERIES FOR LEAKS; G. L. Kyle, Niagara Falls, N. Y. App. filed Nov. 4, 1920.

1,644,016. PNEUMATICALLY CONTROLLED RHEOSTAT; H. V. Haight, Sherbrooke, Quebec, Canada. App. filed Aug. 17, 1926.

1,644,017. DRY CELL; W. F. Hendry, Ossining, N. Y. App. filed Nov. 8, 1923. Desiccated cell.

1,644,024. LIGHTING CIRCUIT; R. G. McCurdy, Englewood, N. J. App. filed June 1, 1925. A device adapted to be inserted in a series circuit to insure continuity of service and to avoid any wave-form distortion in the circuit.

1,644,038. LAMP GRIP; M. N. Russell, Syracuse, N. Y. App. filed March 7, 1925. For retaining lamps in a socket.

1,644,056. VENTED ELECTRIC SOCKET; H. A. Hallowell, Woodlynne, N. J., and E. D. Hallowell, Audubon, N. J. App. filed July 8, 1925.

1,644,069. HEATER FOR ROLLS; R. L. McIntosh, Indiana Harbor, Ind. App. filed Dec. 3, 1924. As used in sheet mills.

1,644,100. ELECTRIC TIMING SWITCH; C. F. Amos, Rochester, England. App. filed July 17, 1926. Particularly suitable for use with electric toasters.

1,644,102. ELECTRICALLY OPERATED INDICATING DEVICE; E. S. Betterley, Surbiton, England. App. filed Jan. 21, 1927.

1,644,107. MUFFLE FURNACE; W. G. Bridge, Newton, Mass., and W. A. Pervier, Watertown, Mass. App. filed April 17, 1926.

1,644,124. AUTOMATIC FIRE-ALARM SIGNAL; F. H. Gruettner, Buffalo, N. Y. App. filed Dec. 7, 1922.

1,644,135. REACTOR; W. B. Kirke, Bronxville, N. Y. App. filed Oct. 9, 1925. Of high current and kva. capacity.

1,644,158. SYSTEM FOR GENERATING AND DISTRIBUTING ELECTRICITY; C. F. Strong, New York, N. Y. App. filed June 25, 1919. Farm-lighting plant.

1,644,230. ELECTRICAL LIGHTER FOR GAS STOVES; E. P. Bogan, Detroit, Mich. App. filed Dec. 22, 1924.

1,644,237. ELECTRIC ARC WELDING TOOL; W. D. Christensen, Pueblo, Col. App. filed June 29, 1925.

1,644,255. ELECTRICAL HEATING DEVICE; A. J. Kercher, Berkeley, Cal., and W. W. Hicks, San Francisco, Cal. App. filed Sept. 2, 1926. Cooling element.

1,644,268. TROLLEY SUPPORT; G. W. Packer, Chicago, Ill. App. filed Dec. 25, 1926.

1,644,291. CABLE CONNECTER; H. L. Strongson, Brooklyn, N. Y. App. filed Oct. 18, 1923. For outlet boxes.

1,644,292, 1,644,293. CABLE CONNECTER; G. C. Thomas, Jr., Elizabeth, N. J. Apps. filed Jan. 22, 1924. For outlet box.

1,644,294. CABLE CONNECTER; J. C. Ledbetter, Brooklyn, N. Y. App. filed Jan. 22, 1924. For outlet boxes.

1,644,295, 1,644,296, 1,644,297. CABLE CONNECTER; G. C. Thomas, Jr., Elizabeth, N. J. Apps. filed Jan. 22, 1925. For outlet boxes.

1,644,298. CABLE CONNECTER; J. C. Ledbetter, Brooklyn, N. Y. App. filed Jan. 22, 1924. For outlet box.

1,644,299. CABLE CONNECTER; A. McMurtrie, New York, N. Y. App. filed March 3, 1924. For outlet boxes.

1,644,300, 1,644,301, 1,644,302. CABLE CONNECTER; J. C. Ledbetter, Brooklyn, N. Y. Apps. filed May 22, 1924, and June 2 and July 1, 1925. For outlet boxes.

1,644,303, 1,644,304. CABLE CONNECTER; G. C. Thomas, Jr., Elizabeth, N. J. Apps. filed July 11, 1925. For outlet boxes.

1,644,305. CABLE CONNECTER; L. H. Church, Elizabeth, N. J. App. filed Aug. 18, 1925. For outlet boxes.

1,644,306, 1,644,307. CABLE CONNECTER; J. C. Ledbetter, New York, N. Y. Apps. filed Sept. 11 and Nov. 24, 1925. For outlet boxes.

New Trade Literature

BRAKES AND SWITCHES. — Bulletins 102-B, 109 and 105-A issued by the Clark Controller Company, Cleveland, describe and illustrate respectively the "Three C" magnetic brake, series or shunt wound direct-current; the "Three C" brakes for alternating-current, and alternating-current motor-starting switches. The bulletins contain complete dimension diagrams.

SWITCHBOARD RECORDING INSTRUMENTS.—Bulletin GEA-585 issued by the General Electric Company, Schenectady, N. Y., describes and illustrates its switchboard recording instruments, type "C-18" and "C-19," direct-current, and types "C-20" and "C-21," alternating-current.

ELECTRIC SIGNAL APPARATUS.—The W. O. Ostrander Electric Works, Inc., 911 Atlantic Avenue, Brooklyn, N. Y., are distributing catalog No. 18, describing and illustrating their various types of electric signal apparatus.

INDUSTRIAL HEATING EQUIPMENT.—The General Electric Company, Schenectady, N. Y., is distributing bulletin GEA-812, covering its air-heating and "clamp-on" units. The company has also issued bulletin GEA-164B, describing and illustrating its metal-melting pots and equipment therefor.

CABINETS. — The Rex Manufacturing Company, Connersville, Ind., has issued a catalog describing and illustrating the various types of "Rex" steel cabinets for electrical or mechanical refrigeration. The company is also distributing a pamphlet describing the "Rex" cabinets for apartments and homes.

MINE LOCOMOTIVES AND CUT-OUTS.—"Modernizing Mine Locomotives" is the title of bulletin GEA-707A issued by the General Electric Company, Schenectady, N. Y., describing and illustrating the equipment available for modernizing mine locomotives. The company is also distributing bulletin GEA-786, covering primary cut-outs for railway signal high-voltage power lines.

SPLIT-PHASE MOTOR. — Bulletin No. 153 issued by the Wagner Electric Corporation, St. Louis, describes the "Wagner" split-phase motor, type "58RB."

INSTRUMENTS.—The General Electric Company, Schenectady, N. Y., has issued bulletin GEA-819, describing and illustrating its horizontal edgewise instruments.

PULVERIZERS. — Catalog J issued by the Bethlehem Steel Company, Bethlehem, Pa., describes the "Bethlehem" pulverizer. It contains many illustrations and line drawings and covers in detail the advantages of the pulverizer.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Bucharest, Rumania (No. 27,731), for rubber insulating tape.

Purchase is desired in Lausanne, Switzerland (No. 27,721), of electric household refrigerators.

An agency is desired in Rio de Janeiro, Brazil (No. 27,733), for electric domestic washing machines.

Specifications for 22,000-volt transformers and spares required by the State Electricity Commission of Victoria have been received from Trade Commissioner Elmer G. Pauly, Melbourne, and may be obtained from either the New York or Chicago district office of the bureau. The closing date for tenders is Dec. 12, 1927.

Specifications for electric soldering irons, C-259, required by the Posts and Telegraphs Department, Melbourne, Australia, have been received from Trade Commissioner Elmer G. Pauly and may be consulted at the New York and Chicago district offices of the bureau or in the Washington office. The closing date for tenders is Dec. 6, 1927.